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ENVIRONMENTAL RADIOACTIVE BACKGROUND SURVEY FOR THE AIR FORCE NUCLEAR ENGINEERING TEST FACILITY

DAVID O. LINTZ

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AIR FORCE FLIGHT DYNAMICS LABORATORY
RESEARCH AND TECHNOLOGY DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

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DAVID O. LINTZ

FOREWORD

This technical report was prepared by the Health Physics Office and was initiated under Project No. 7001, "Applied Research for the Design and Construction of the Air Force Nuclear Engineering Test Facility", Task No. 700117, "Determination of the Radioactive Background of the AF NETF Site and Surrounding Area". All work was administered by the Nuclear Facility Branch of the Air Force Flight Dynamics Laboratory, Research and Technology Division.

The Project Engineer on the study was Mr. David O. Lintz, Chief of the Health Physics Office, assisted by Mr. John R. Trigg and Mr. Billy I. Johnson.

The report covers work accomplished from 1 June 1957 to 30 June 1959.

The manuscript of this report was released by the author October 1965 for publication as an RTD Technical Report.

Environmental radioactive background surveys are essential and are recommended by the Atomic Energy Commission to any company or concern planning to build an atomic reactor.

This technical report has been reviewed and is approved.

Stanley G. Fidler
Stanley G. Fidler
Chief, Nuclear Facility Branch
Vehicle Equipment Division
Air Force Flight Dynamics Laboratory

ABSTRACT

This environmental radioactive background survey was an attempt to establish a base line of the normally occurring radioactivity in the fauna and flora of a particular area subsequent to the operation of a reactor which will release additional radioactivity to the environment. The Health Physics Office of the AF NETF has collected samples of water, soil, air, sewage, milk, biological life and vegetation in a 20 mile radius of the AF NETF site and analyzed the samples for alpha, beta and gamma activity. The results of the analyses over the period of the report are given in graphic form to facilitate making comparison of the fluctuations in the normal background. The wide variations were due to the atom bomb testing not only in the United States but throughout the world. The tests especially noticeable are the result of the last half quarter of 1958 when the atom bomb testing was at a peak.

Future samples taken from the same areas will be analyzed when the reactor becomes operational. Comparison then can be made to determine any increased activity which may be attributable to the Air Force Nuclear Reactor Operation.

In order to obtain certain quantitative analyses of the radioactive content of the various samples collected a contract was awarded the Nuclear Science and Engineering Corporation of Pittsburgh, Pennsylvania. The result of their work will be found in Appendix II of the report.

CONTENTS

SECTION I

INTRODUCTION

At the suggestion of the Atomic Energy Commission, the Health Physics Office of the Air Force Nuclear Engineering Test Facility has conducted an area radioactivity background survey for naturally occurring radioactive materials in the environs of the facility at Wright-Patterson Air Force Base, Ohio. This survey was conducted primarily to obtain a base line of naturally occurring radioactivity prior to start up of the nuclear reactor being constructed at the Wright-Patterson Air Force Base.

The naturally occurring background activity is gradually increasing because of the many nuclear bombs detonated by Russia, England and the United States. It is estimated that several hundred atomic and hydrogen bombs have been detonated to date. This survey covers the gross beta gamma activity occurring in air, water, soil, vegetation, milk and sewage.

The original plans for the area background survey were formulated in September 1956. At that time instruments were not available to conduct the planned survey. Immediate steps were taken to secure the necessary instrumentation. By February 1957 a limited number of radiation detection instruments had been procured along with a panel truck for collection of samples. A preliminary sampling schedule was arranged and pick up of samples was begun. The panel truck was used for collection of samples within a twenty mile radius of the reactor site.

In general the determination of the background radiation follows the pattern established for environmental monitoring at other reactor sites. Since the background measurements are for gross alpha, beta and gamma activity, it was felt that a quantitative analysis should be performed by an outside agency under contract. Such a contract was awarded the Nuclear Science and Engineering Corporation of Pittsburgh, Pennsylvania.

SECTION II

THE AF NETF ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAM

A. GENERAL

The personnel of the Health Physics Office, Air Force Nuclear Engineering Test Facility collects, prepares, analyzes, interprets, records and reports the radioactive content of samples of soil, water, sewage, milk, vegetation and biological life of the AF NETF site and the surrounding cities of Springfield, Xenia, Yellow Springs, Fairborn and Dayton, Ohio. The Springfield sampling sites are 23 miles from the reactor site in the down wind direction.

Collection preparation and analysis procedures in effect as of 30 June 1959, together with data results and interpretation from all samples collected from 1 June 1957 through 30 June 1959 are presented on the following pages.

B. SAMPLE COLLECTION

All environmental samples were collected at weekly intervals from the sites chosen in or near the cities listed above.

These samples include tap water, river water, top soil, air, milk, and vegetation.

C. SOIL SAMPLES

Soil samples were chosen from the first 1/4 to 1/2 inches of soil being careful not to include stones or other coarse materials. Approximately 100 gram samples were collected and placed into small manila envelopes, sealed and marked as to location collected. Soil sample collection sites were chosen in areas which have not been cultivated for at least twenty years. This was done in order to avoid the additional K^{40} activity contributed through the use of commercial fertilizers.

Surface soil samples were taken to provide an estimate of possible radioactivity from natural and acquired emitters. Samples were analyzed for gross beta and alpha emitters by the Health Physics Office. These determinations were conducted over a period of two years- from June 1957 through June 1959.

Specific isotopic determinations of the relative abundance of Strontium^{90}, Zirconium^{95}, Ruthenium^{130}, Cs^{137}, and for total potassium content in soil samples were concurrently performed under the provisions of Contract No. 3?(616)-5909 by the Nuclear Science and Engineering Corporation of Pittsburgh, Pennsylvania*.

D. WATER SAMPLES

All water samples were collected in two liter polyethylene bottles marked as to location of sample site. In all cases, the drinking water samples were taken directly from a tap usually at some gasoline service station located within the city limits since all city water supplies originate from drilled wells rather than being pumped from some stream. However, three samples were obtained from streams, one each from Beavercreek, Mad River and the Miami River. Other water samples were obtained from three wells on Wright Field. The Wright Field samples were analyzed by the Ohio State Health Department and a report of the findings supplied to the Health Physics Office.

E. RAINWATER SAMPLES

Samples of rainwater were obtained from four fallout stations, each equipped with an aluminum tray 2 feet x 2 feet x 3 inches deep. A five gallon polyethylene bottle was located inside the station house to receive the rain water samples. Samples were marked as to location when picked up from the fallout station. During the winter period all snow samples collected in the fallout station trays were melted down, concentrated and counted as other water samples.

*See Appendix II

F. VEGETATION SAMPLES

Sampling of vegetation proved somewhat of a problem in choosing the proper specimen which has a fairly long growing season and at the same time grows rather rapidly. The plant finally chosen, which is wide spread in this area, was common dock. Collections were made from areas which had not been cultivated for many years. This was done in order to avoid the activity that might result from application of high content phosphate fertilizers.

G. MILK SAMPLES

As a matter of interest milk samples were obtained from farms located as near east, west, north and south of Dayton as possible and analyzed for radioactivity. The samples were obtained from the Miami Valley Milk Producers Association. Two liter quantities were obtained weekly for a period of six months covering the grazing period and a portion of the dry feeding period. This was done in order to detect any change that might occur as a result of the cows eating growing vegetation as opposed to the eating of dry foods.

SECTION III
SAMPLE PREPARATION

A. GENERAL

Samples submitted in connection with the environmental monitoring program will consist of routine soil, water, vegetation and fallout samples and occasionally an animal, fowl or fish indigent to the area. The chemical laboratory will prepare these samples for counting according to accepted and recommended procedures used at various atomic energy installations.

B. PREPARATION OF SAMPLES

1. Soil

Free soil samples of any visible foreign matter such as leaves, sticks and stones. Then dry, screen and pulverize the soil in a mortar and transfer a portion of the pulverized soil to a planchet and mark. Dampen the soil with distilled water, if necessary, and dry again in an oven at 110°C or with a heat lamp and submit for counting.

2. Water

Measure out 500 ml of water into a large beaker or bottle and transfer a portion to a 250 ml beaker. Add 2 drops of methyl purple indicator. Add concentrated HNO_3 dropwise until the color of the solution turns purple. Evaporate on a hot plate to a small volume, add more water from the original 500 ml and more acid as necessary to keep the solution acidic. Continue to evaporate in this manner until the water reaches a small volume (15-20 ml). Transfer the solution to a 50 ml beaker, wash the 250 ml beaker with a small portion of distilled water and transfer this to the small beaker. Carefully evaporate to a very small volume (2-5 ml) then remove the beaker from the hot plate. Using a clean dropper, transfer a small portion of the liquid to a planchet and evaporate to almost dryness under an infra-red lamp. Add more liquid and continue the evaporation. Finally rinse the beaker with a few ml of distilled water and transfer to the planchet. Evaporate to dryness and submit for counting.

3. Vegetation

Cut off the leafy portions of the plant, place in a large beaker and dry in an oven at 110°C, preferably overnight. Put the leaves into a large mortar and crush to a powder. Transfer a portion of the powder to a small evaporating dish, place under a hood and ignite by heating with a bunsen burner. After ignition and burning, place the dish in a muffle furnace and heat at 600°C until the contents are thoroughly ashed. Allow the ash to cool then powder with a spatula or pestle. Transfer a portion to a weighed planchet, then reweigh to determine the weight of ash submitted for counting.

4. Fallout Paper

Fold the paper a few times then cut into small pieces into a 100 ml evaporating dish. Place the dish in a ring on a ring stand or tripod under a hood and carefully heat with a bunsen burner so that the paper ignites and burns within the dish. When burning has ceased, transfer the dish to a muffle furnace and heat to 600°C until ashing is complete. Remove from the furnace and allow to cool. Crush the cooled ash into a powder with a spatula or pestle and transfer to a weighed planchet for reweighing and counting.

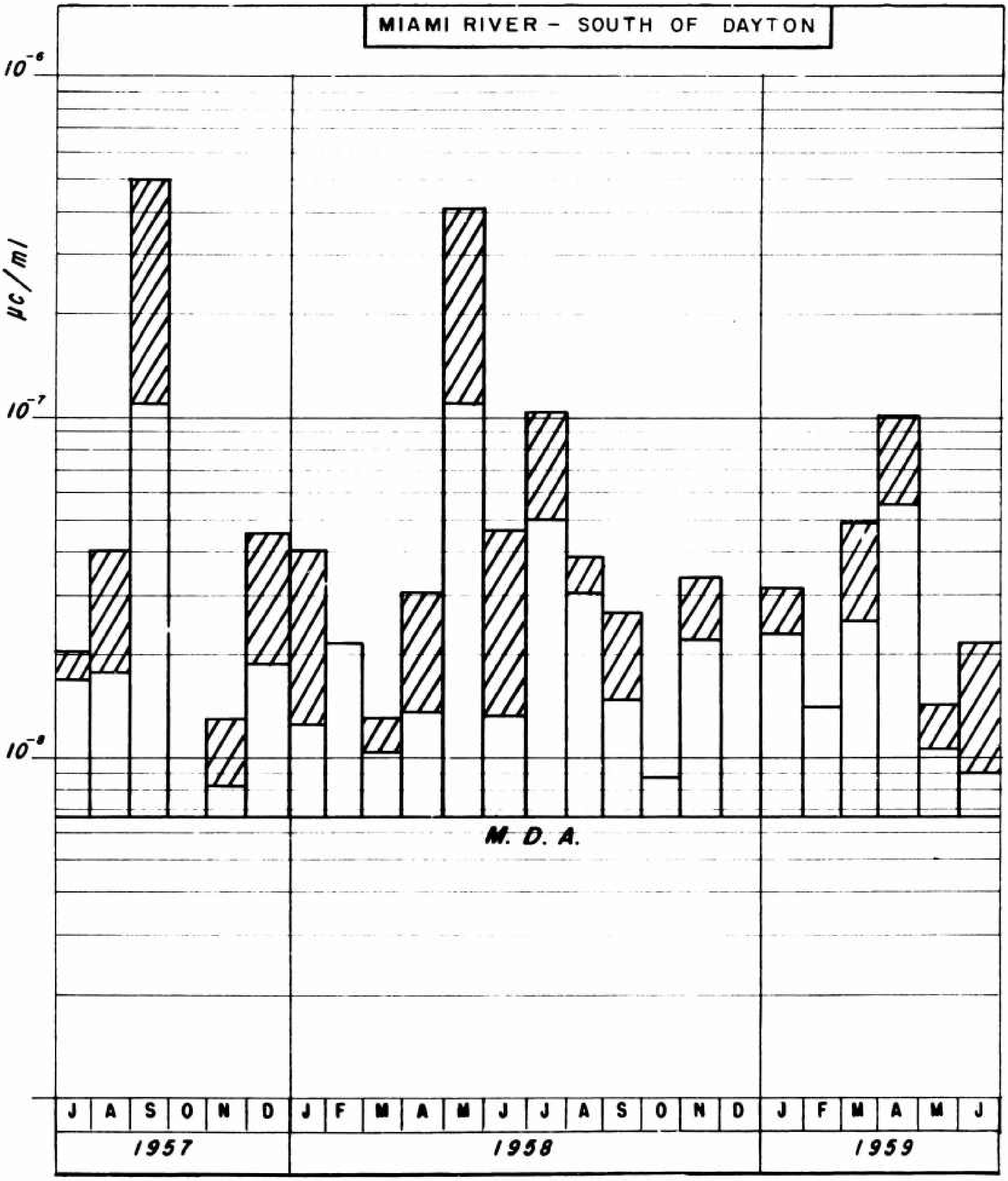
SECTION IV

RESULTS

Rather than list the results in tabular form a bar graph was drawn to show the variation in activity from month to month and from season to season. See Appendix I for a graphic presentation of the results.

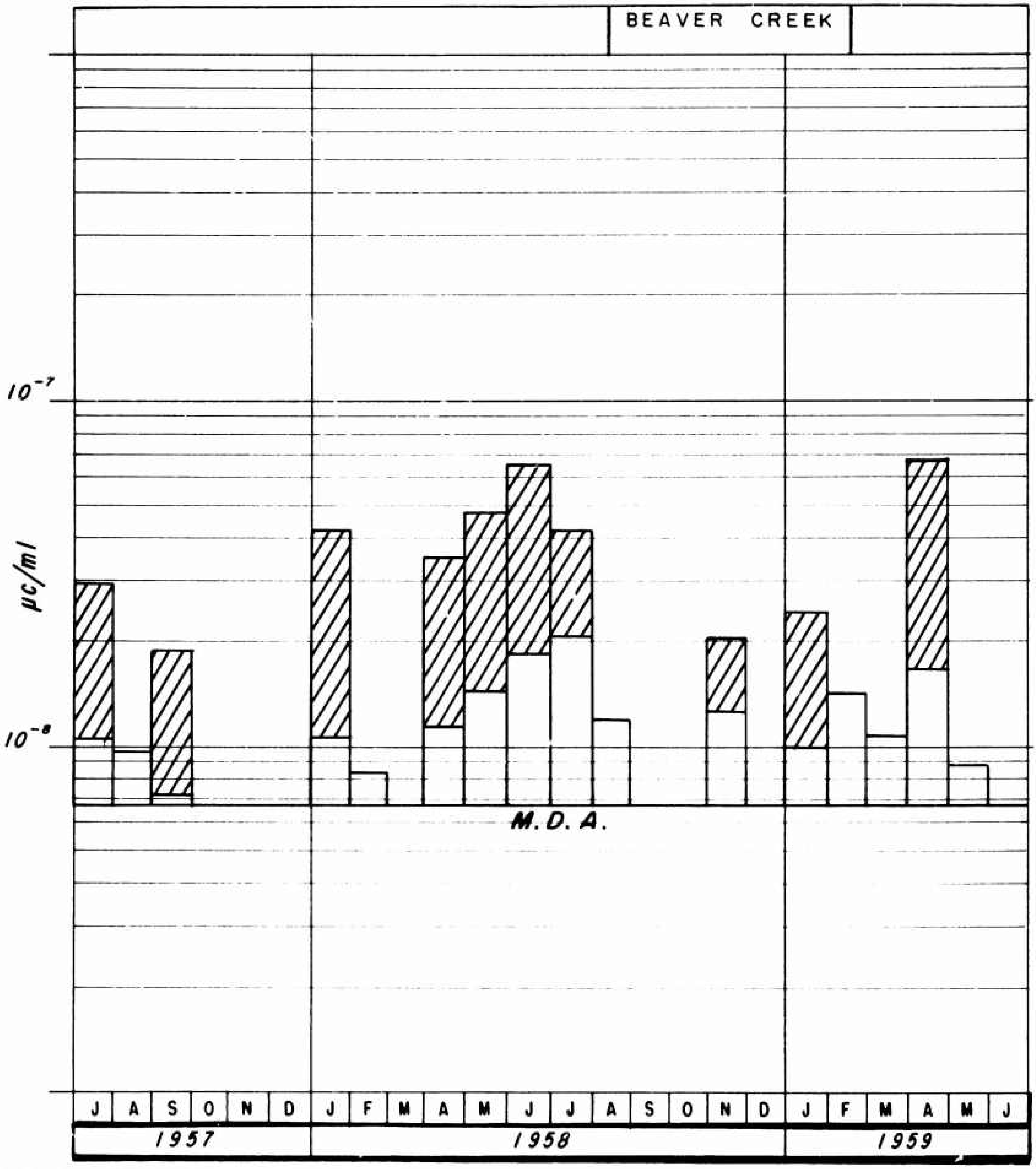
APPENDIX I

GRAPHIC ILLUSTRATION OF RADIOACTIVE BACKGROUND DATA



M.D.A. = Minimal Detectable Activity

The striped area of the bar graphs indicates the maximum radioactivity found during each month's samples



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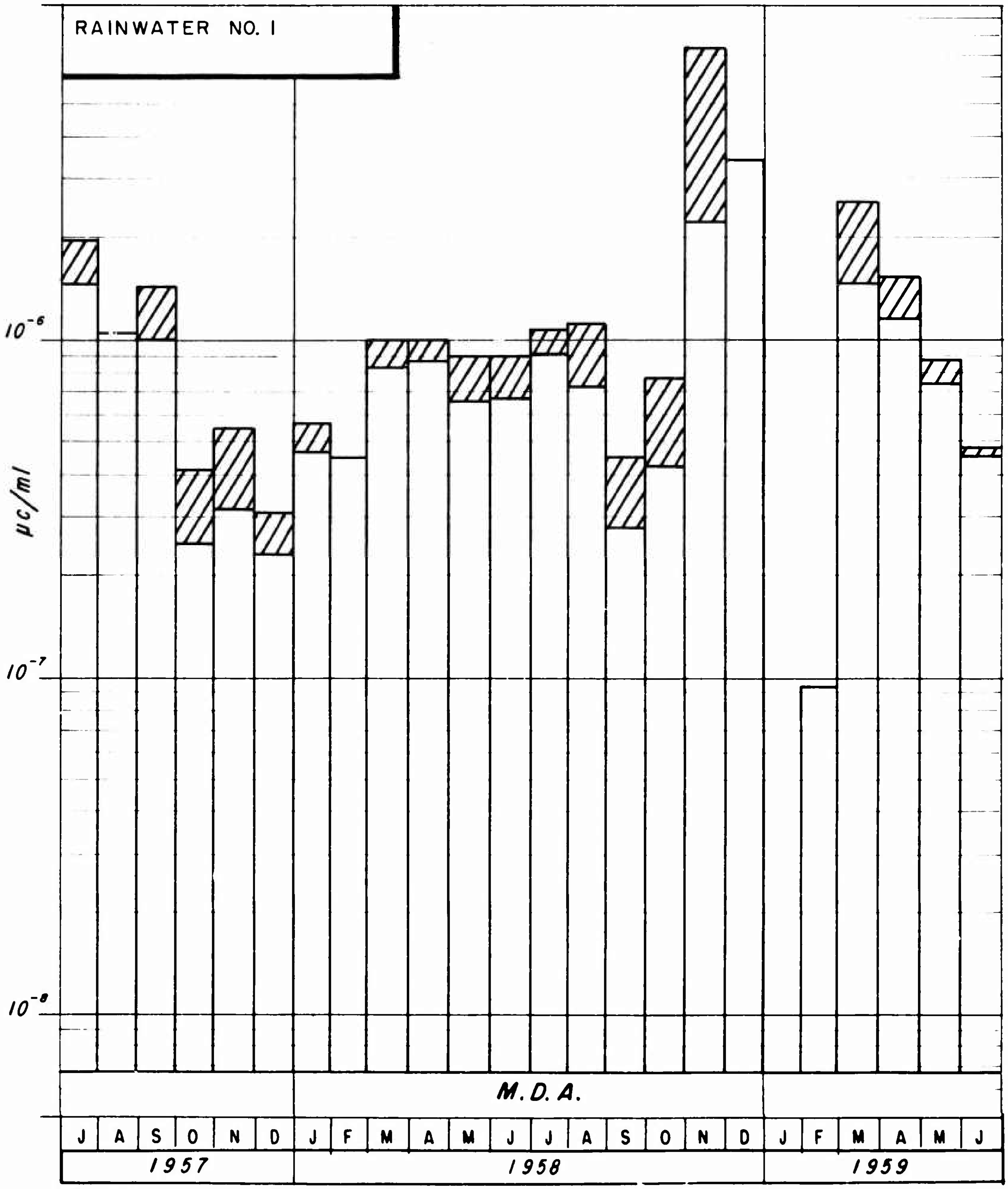

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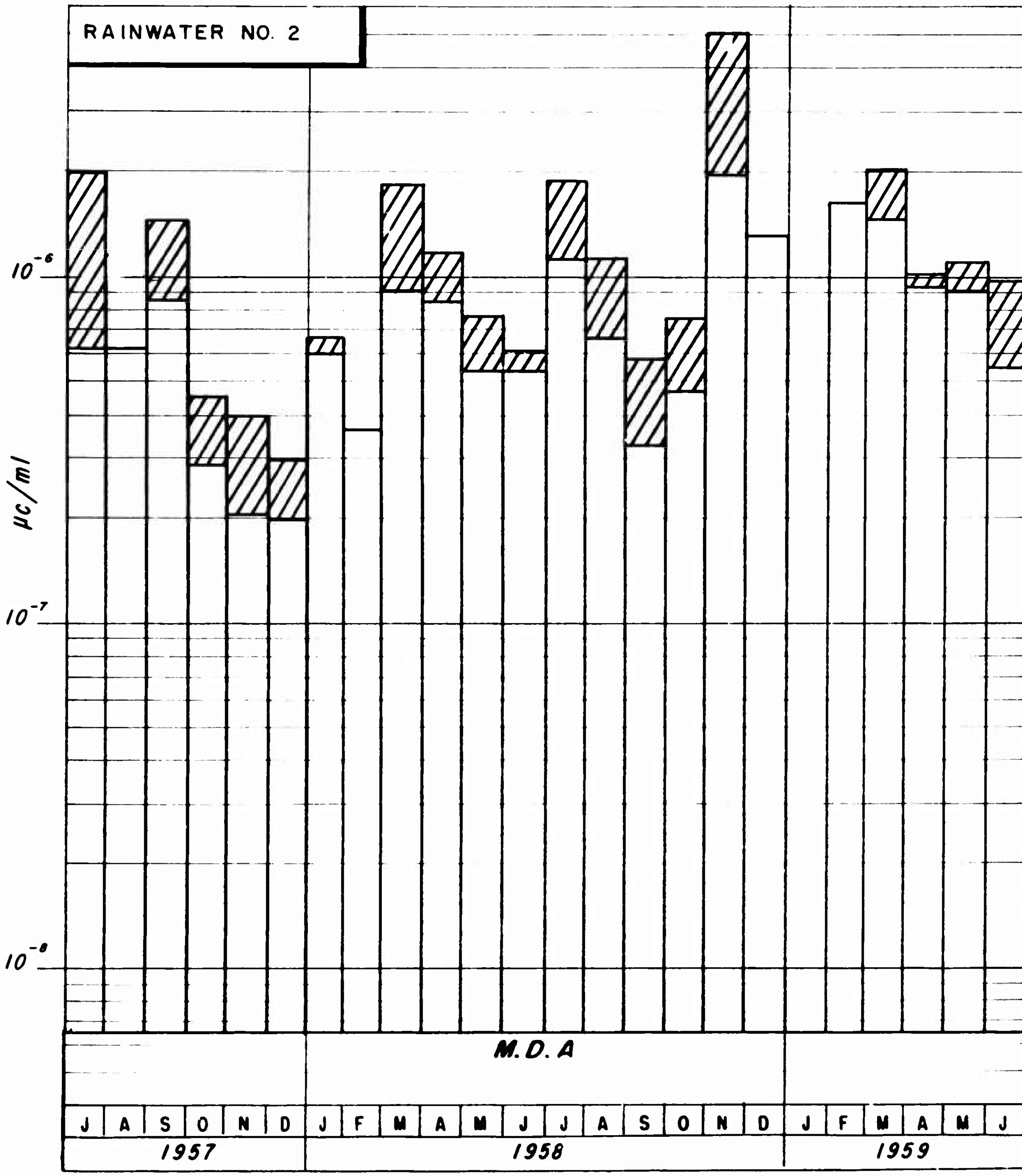

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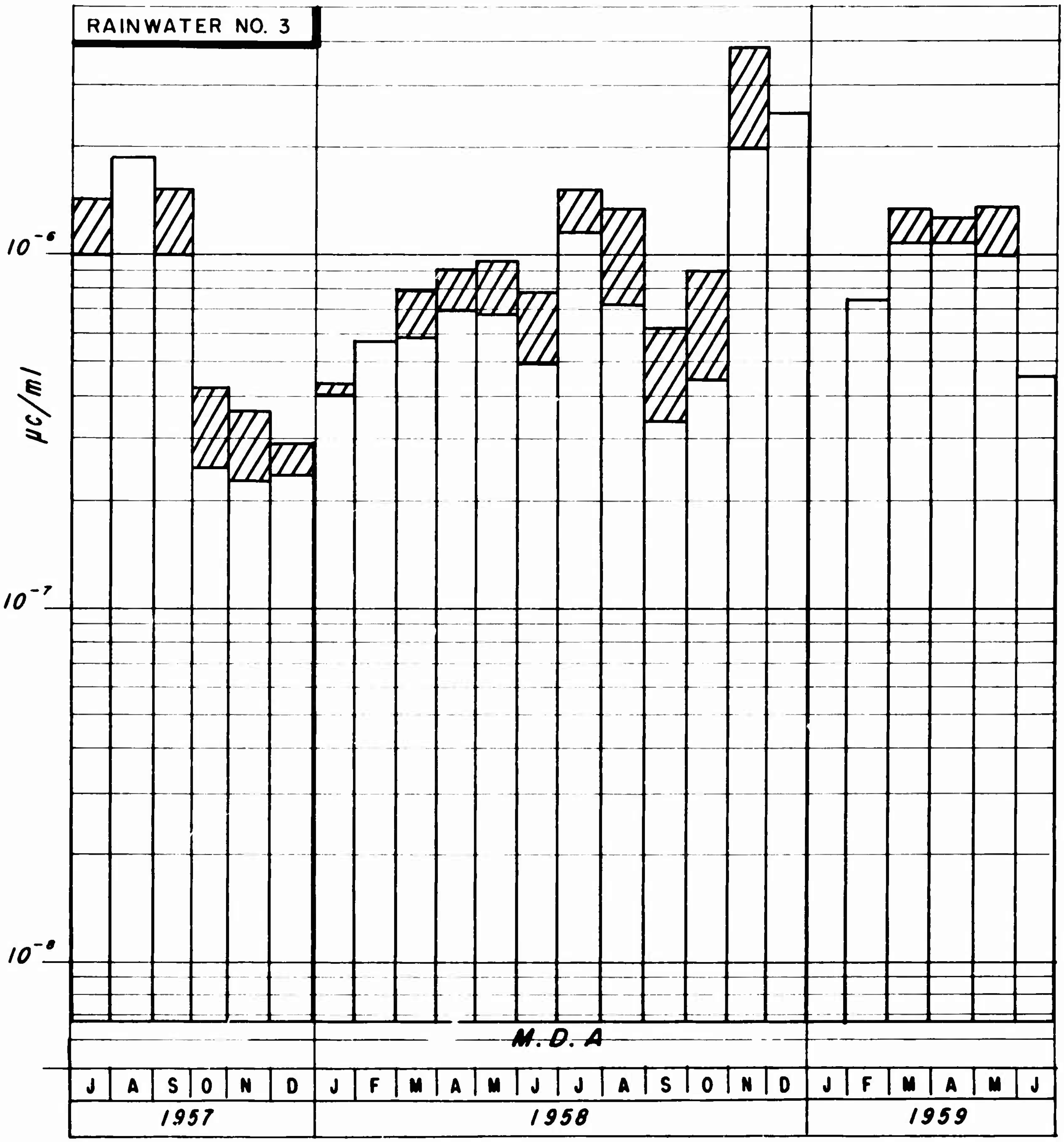

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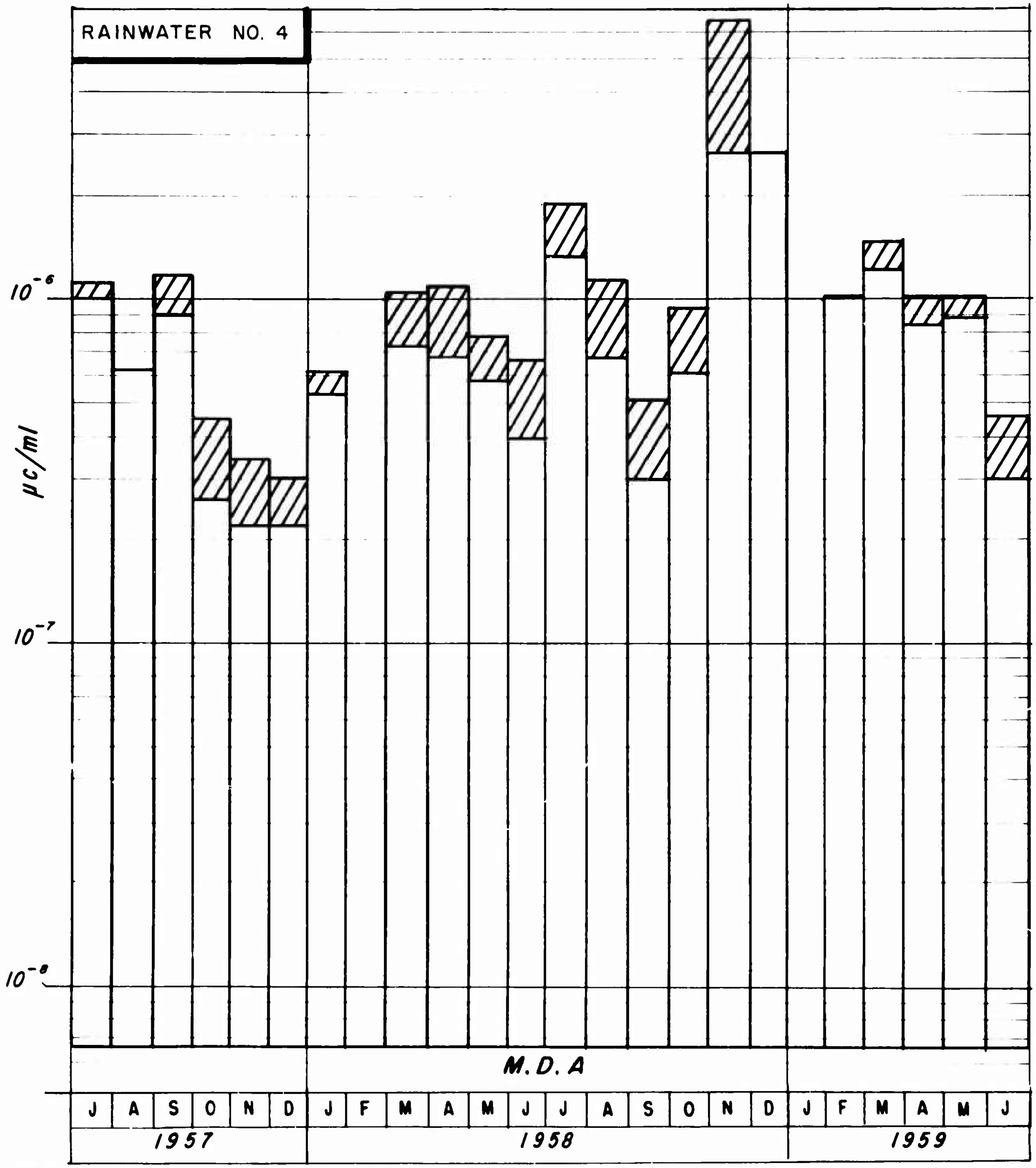

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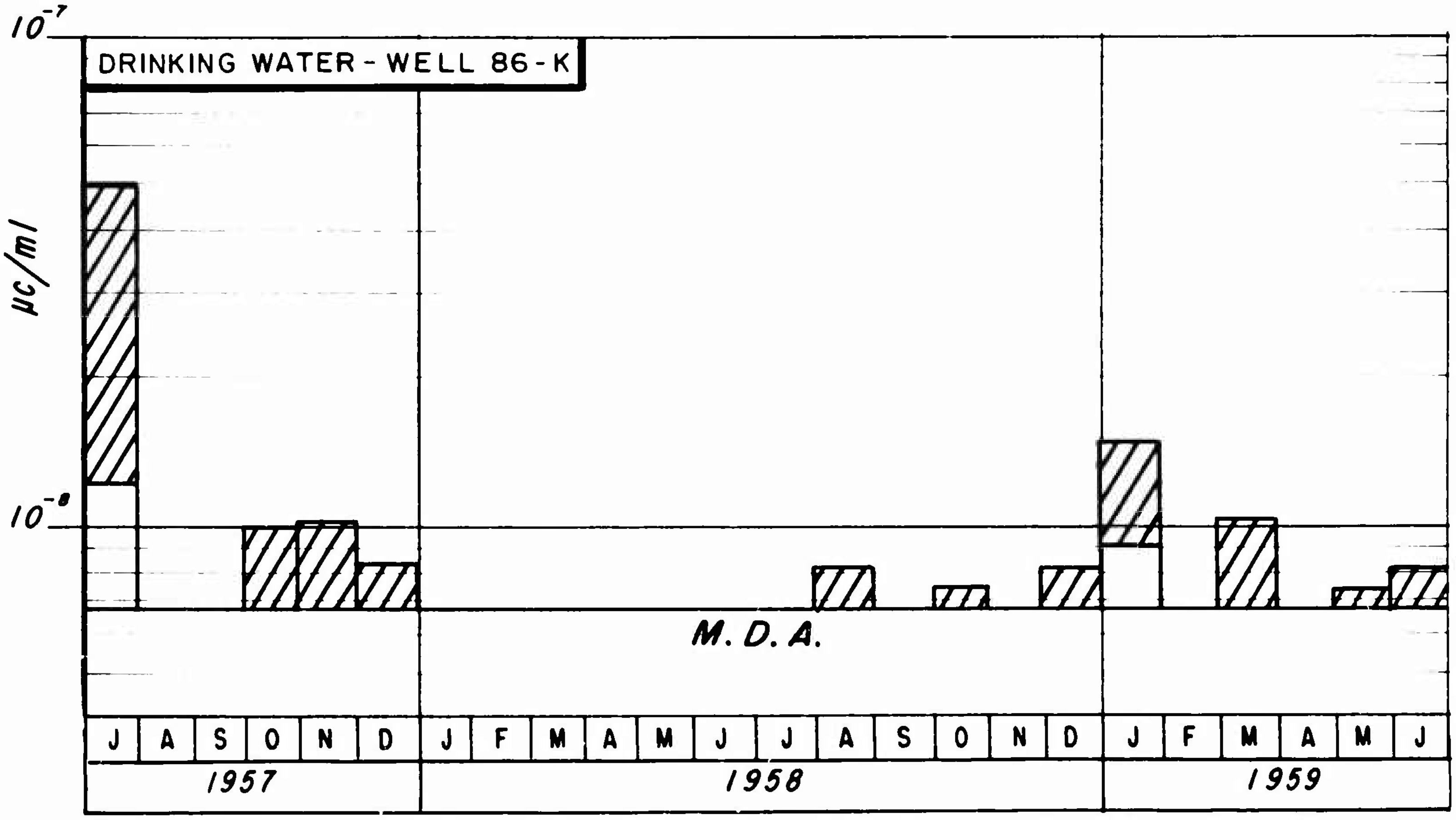

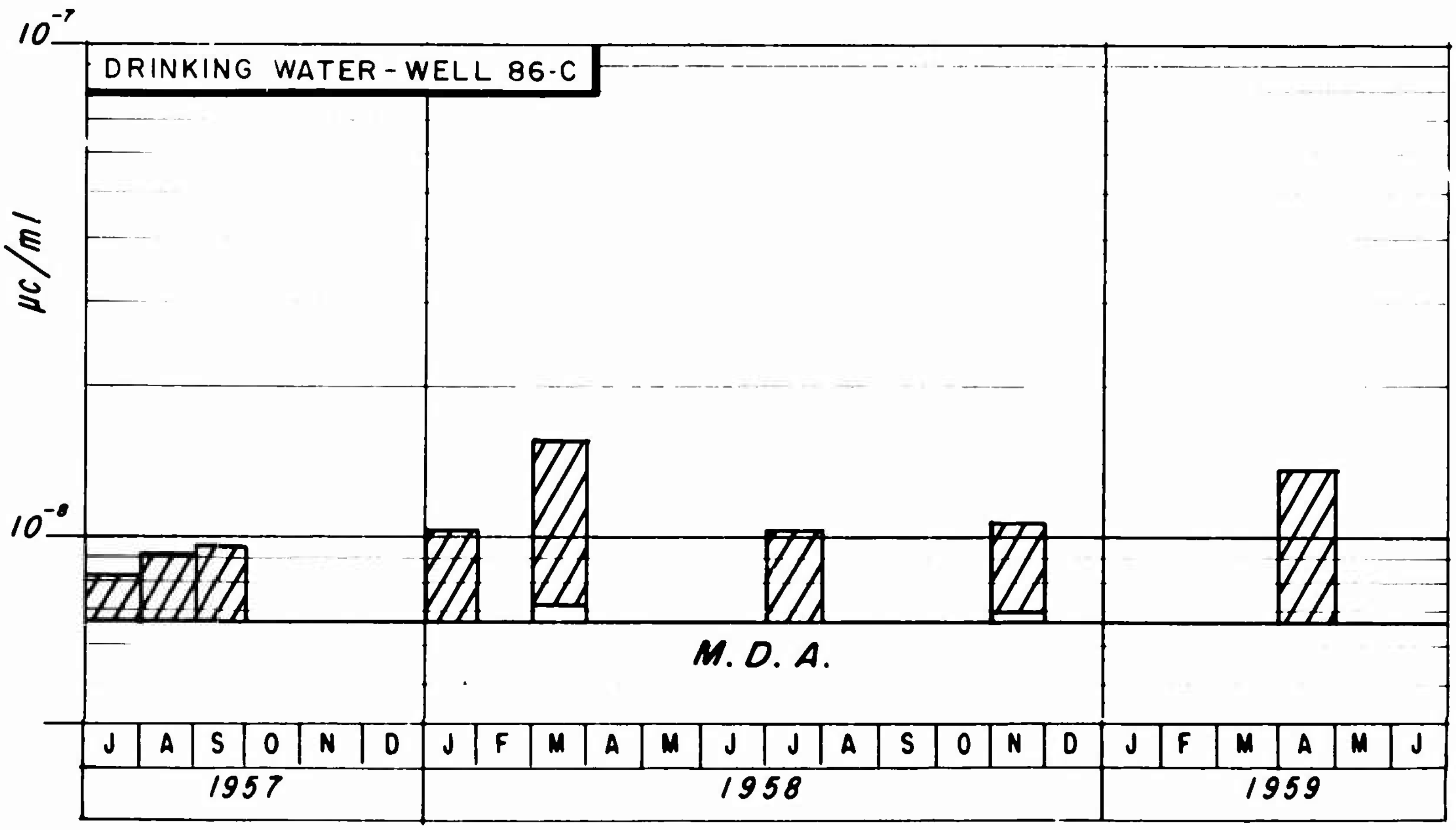

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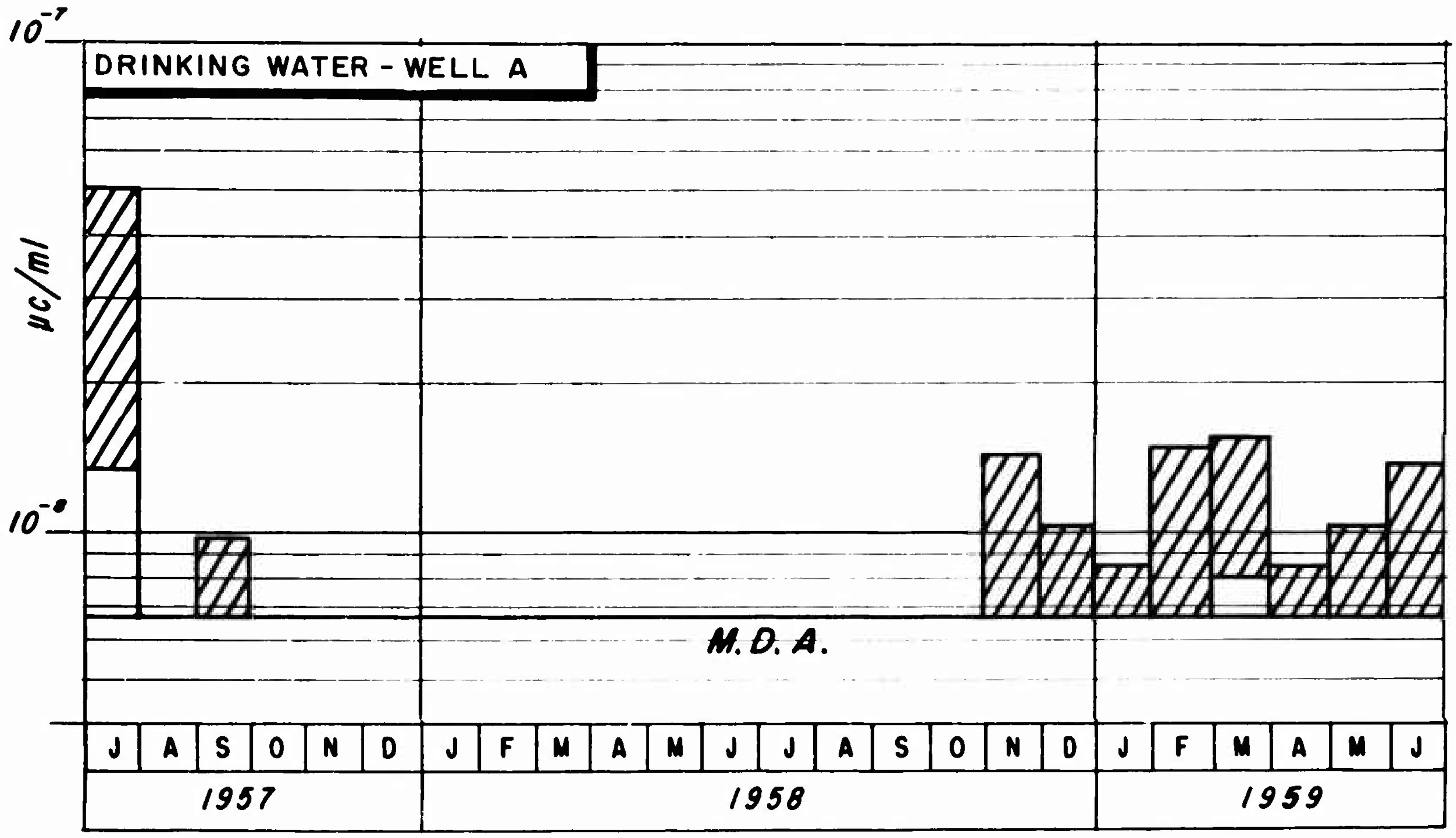

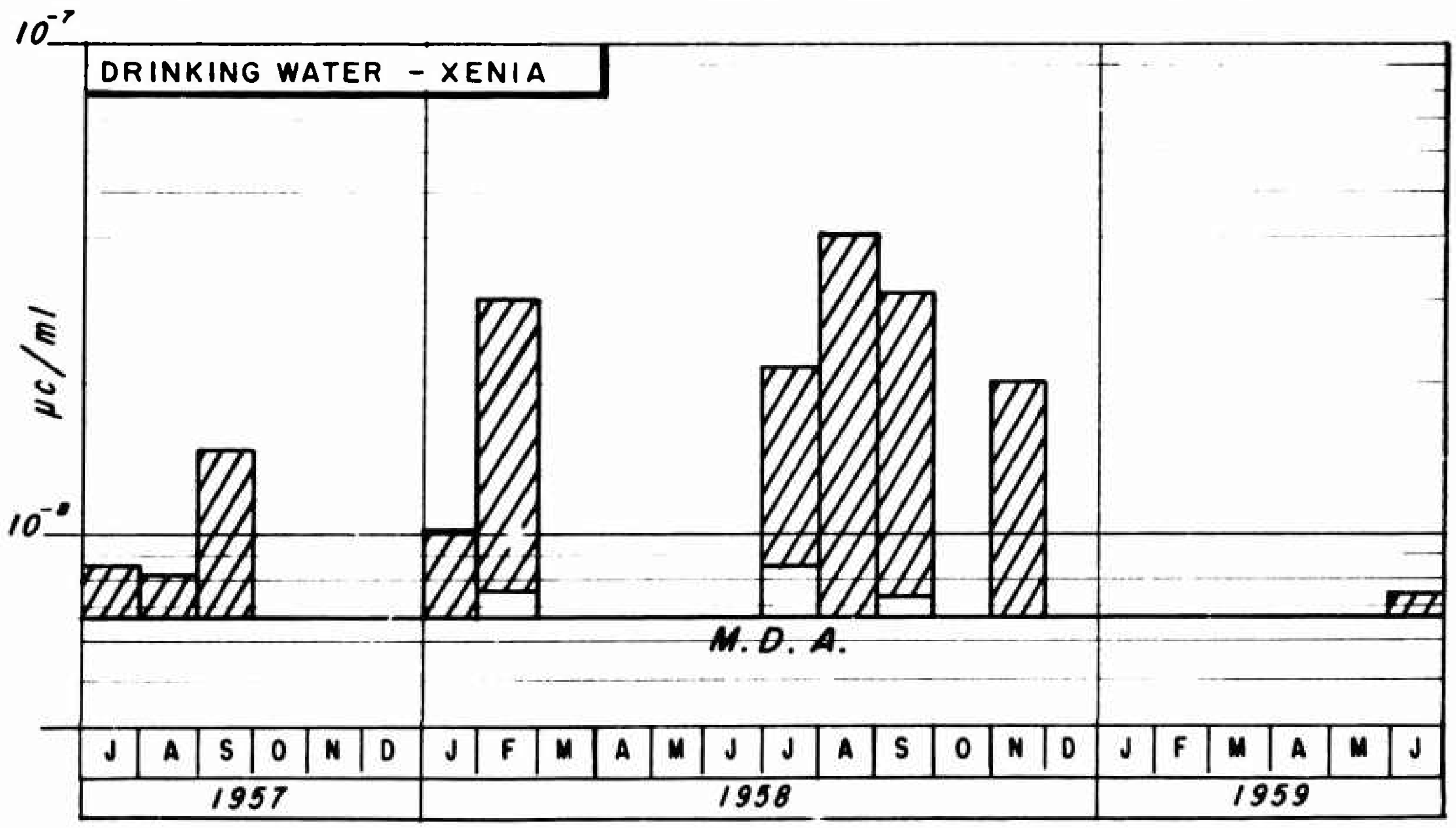

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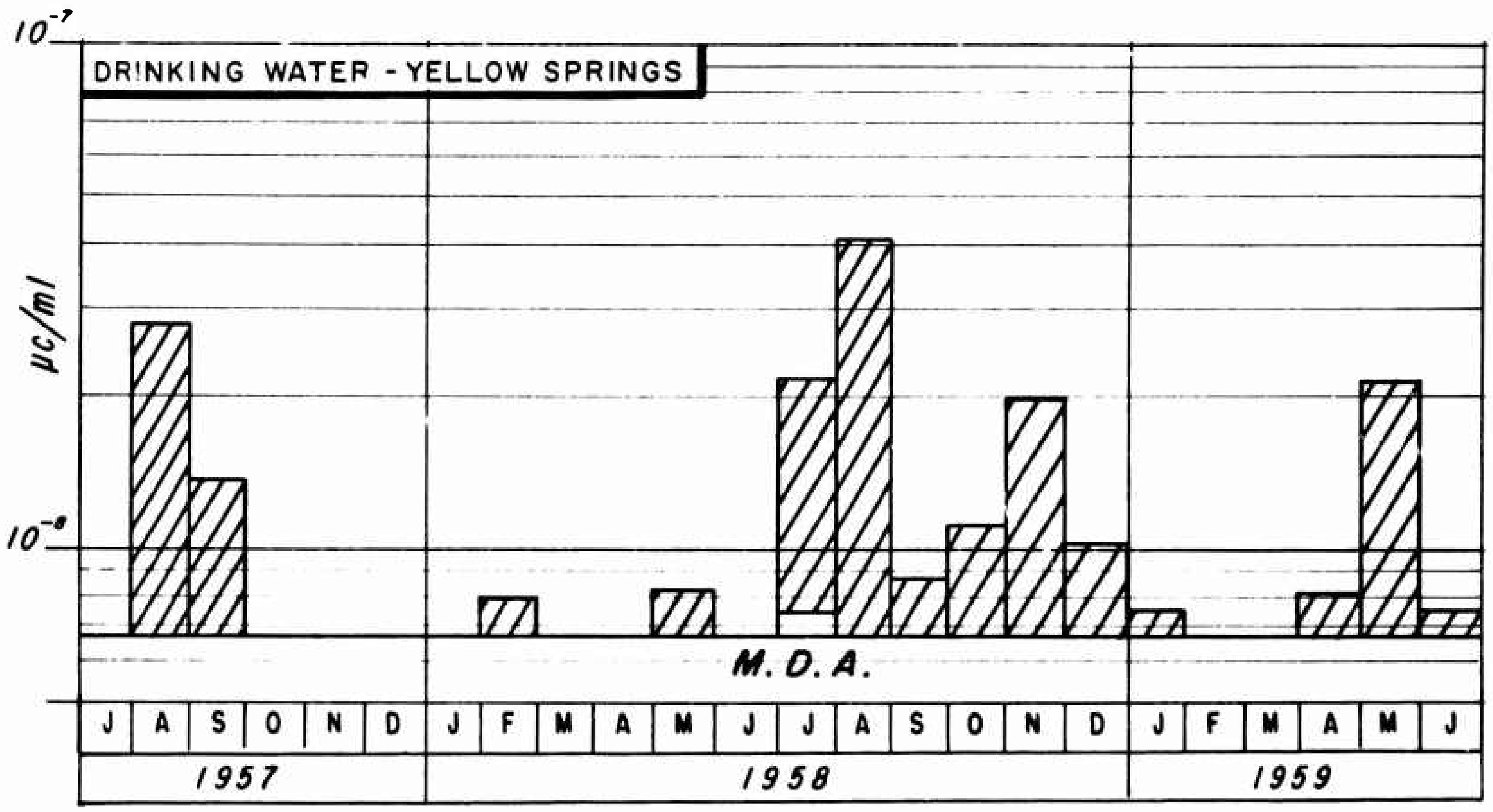

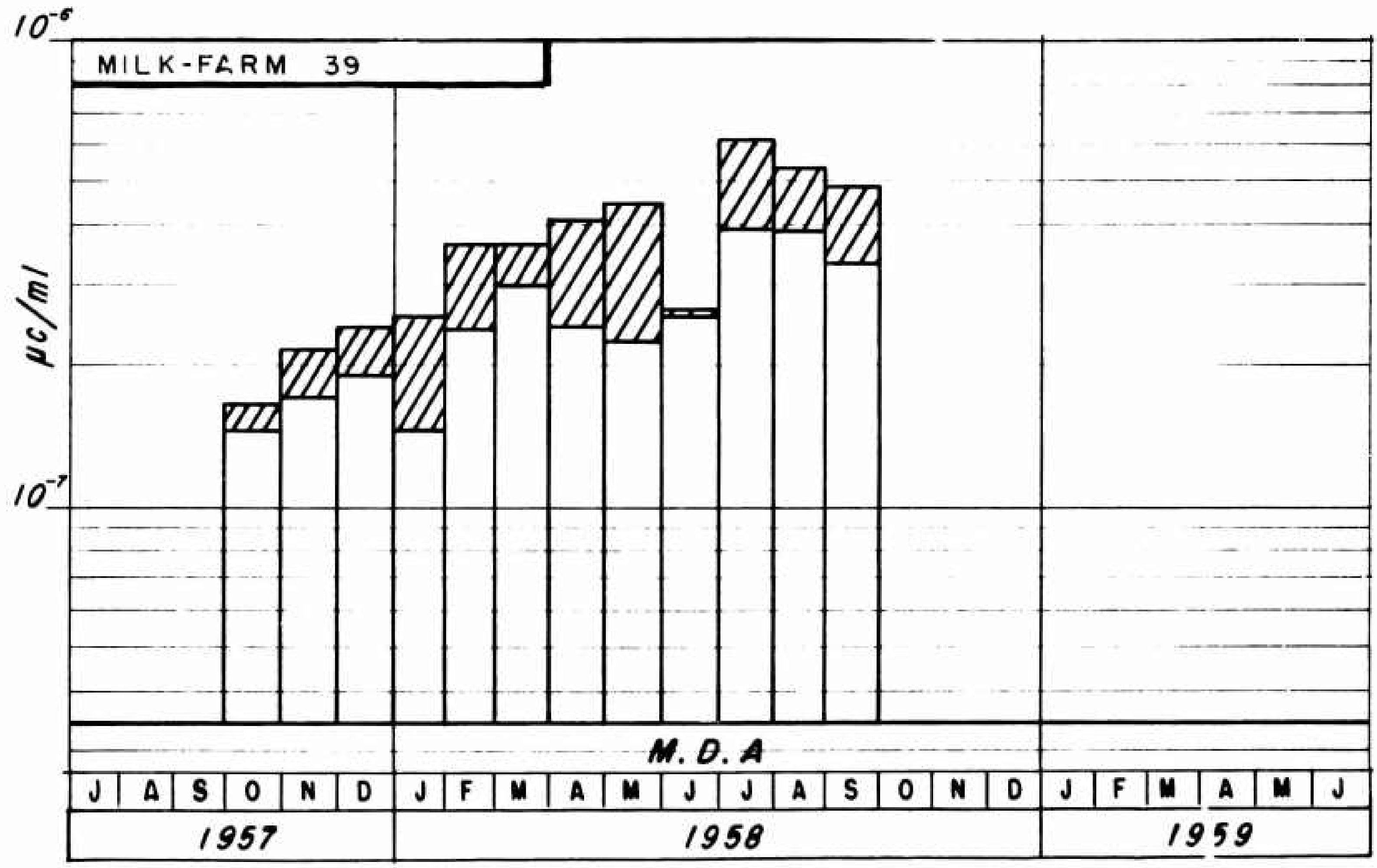

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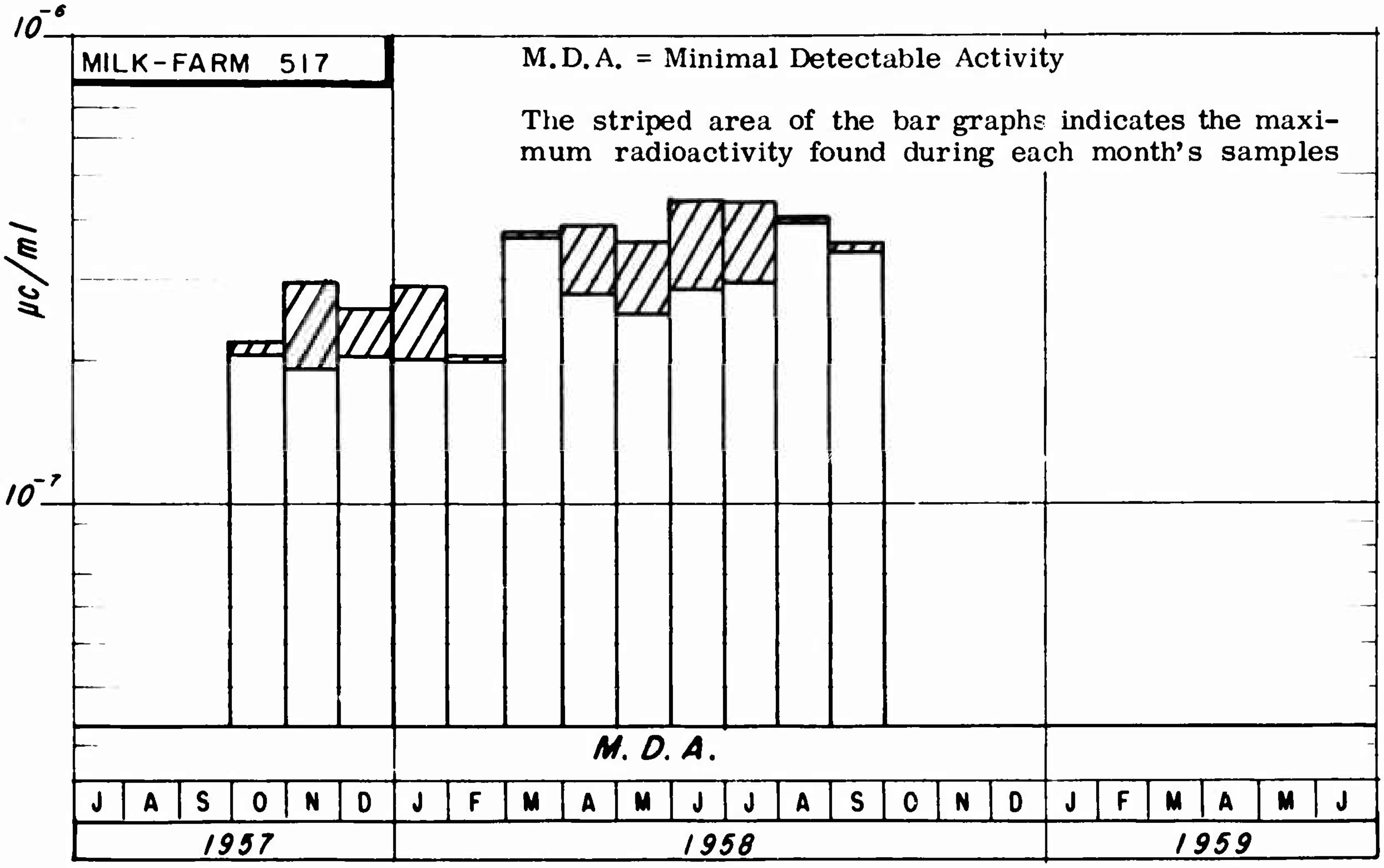

MILK-FARM 517
M.D.A. = Minimal Detectable Activity
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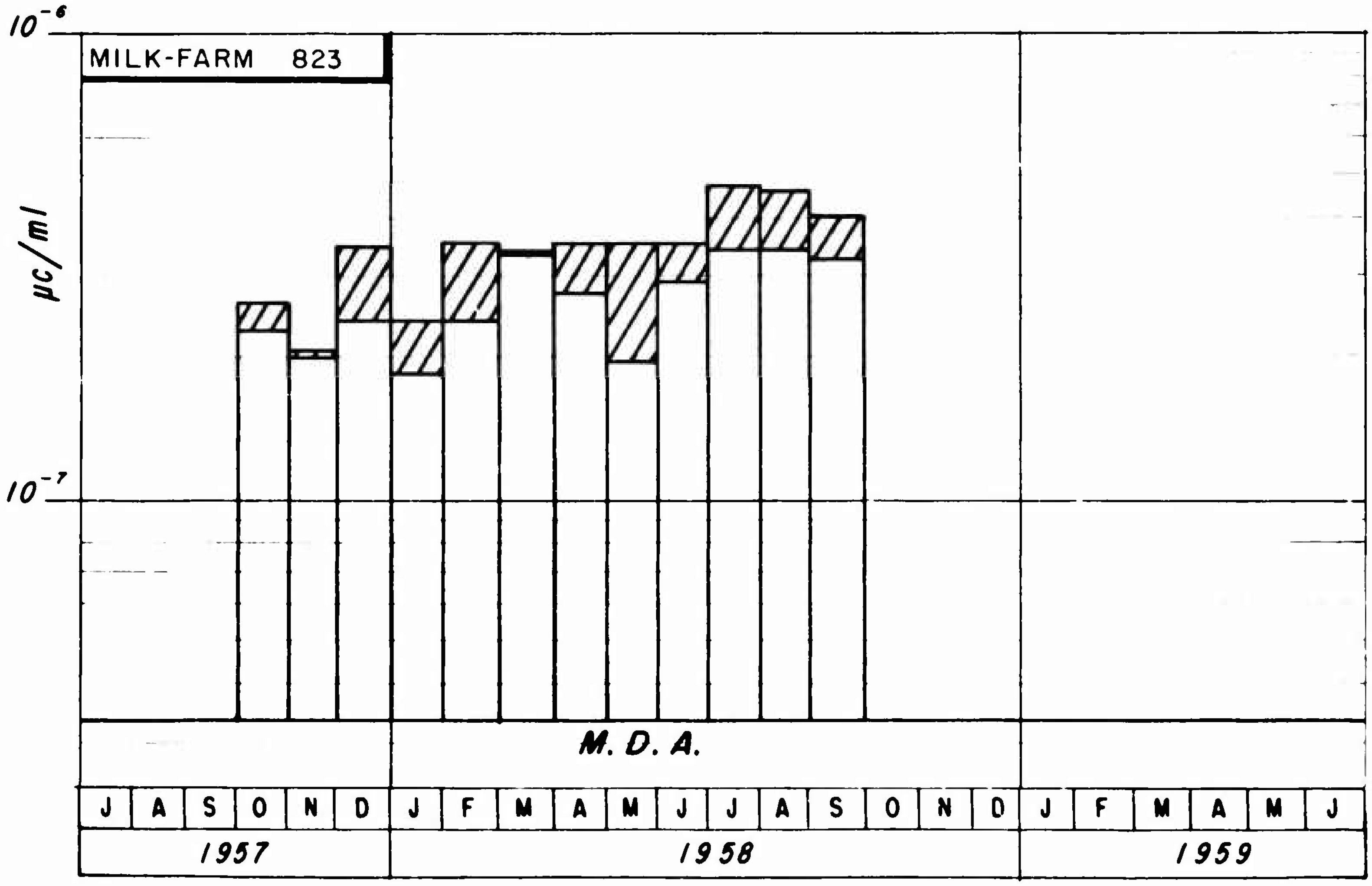

MILK-FARM 823
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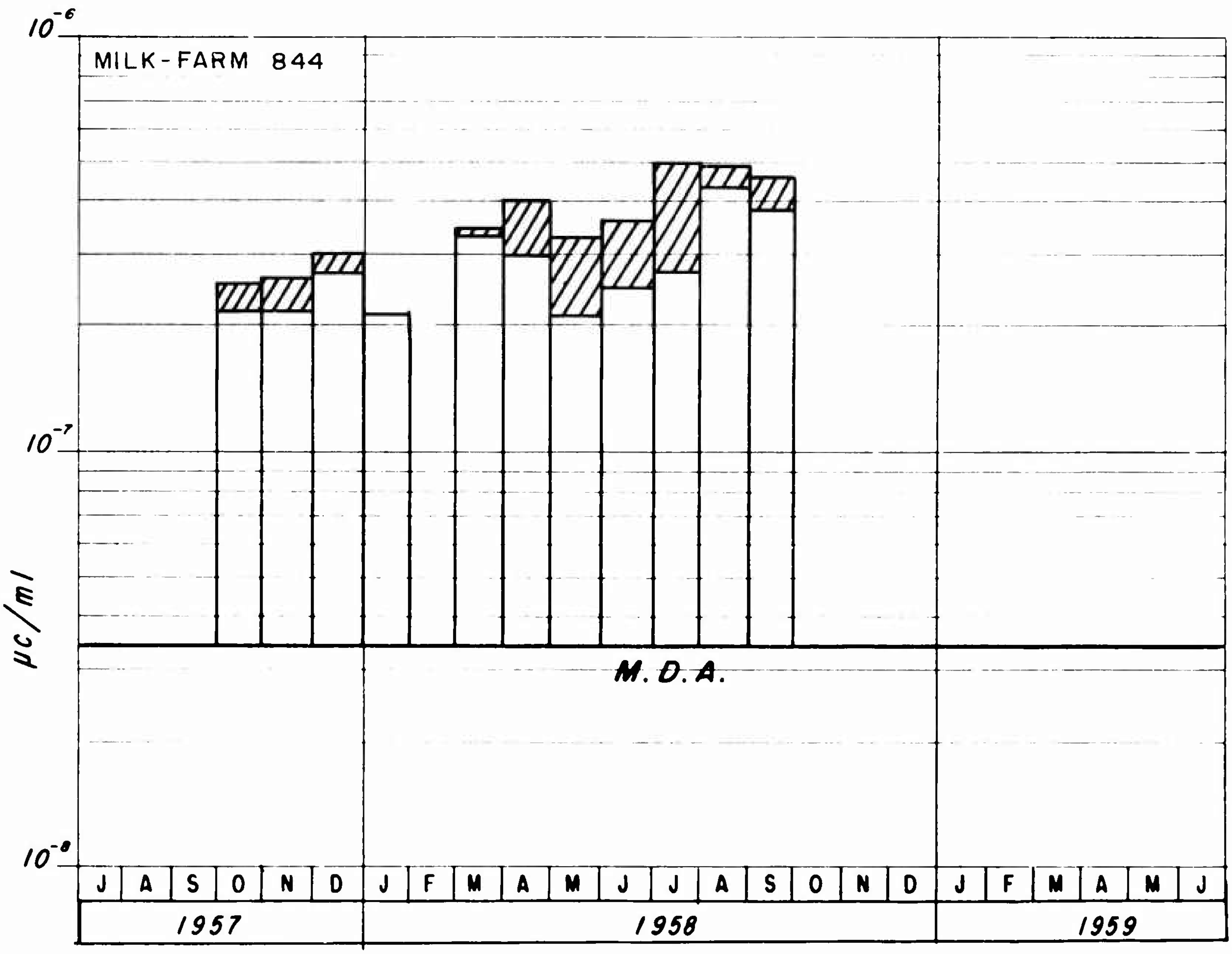
1959



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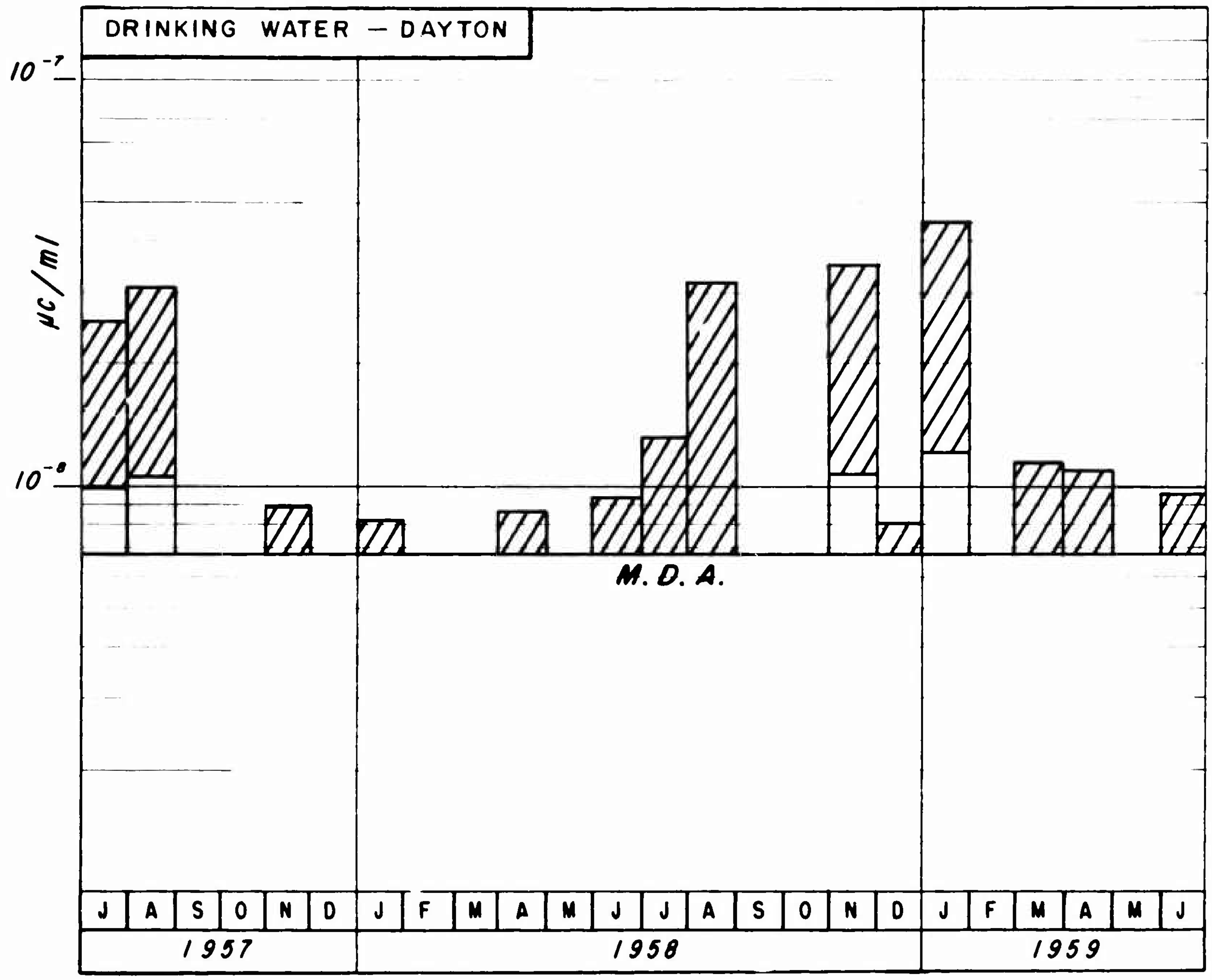

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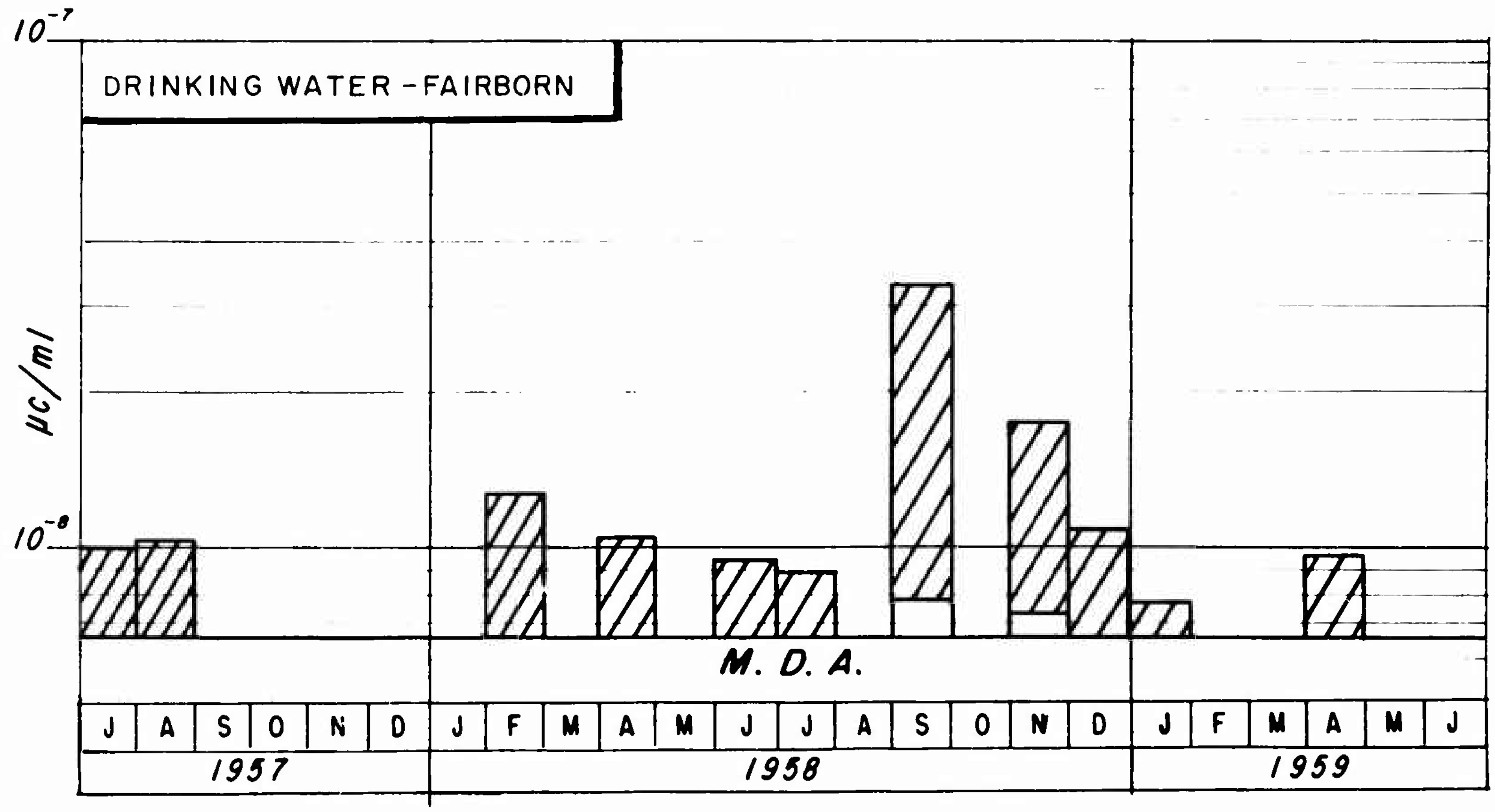

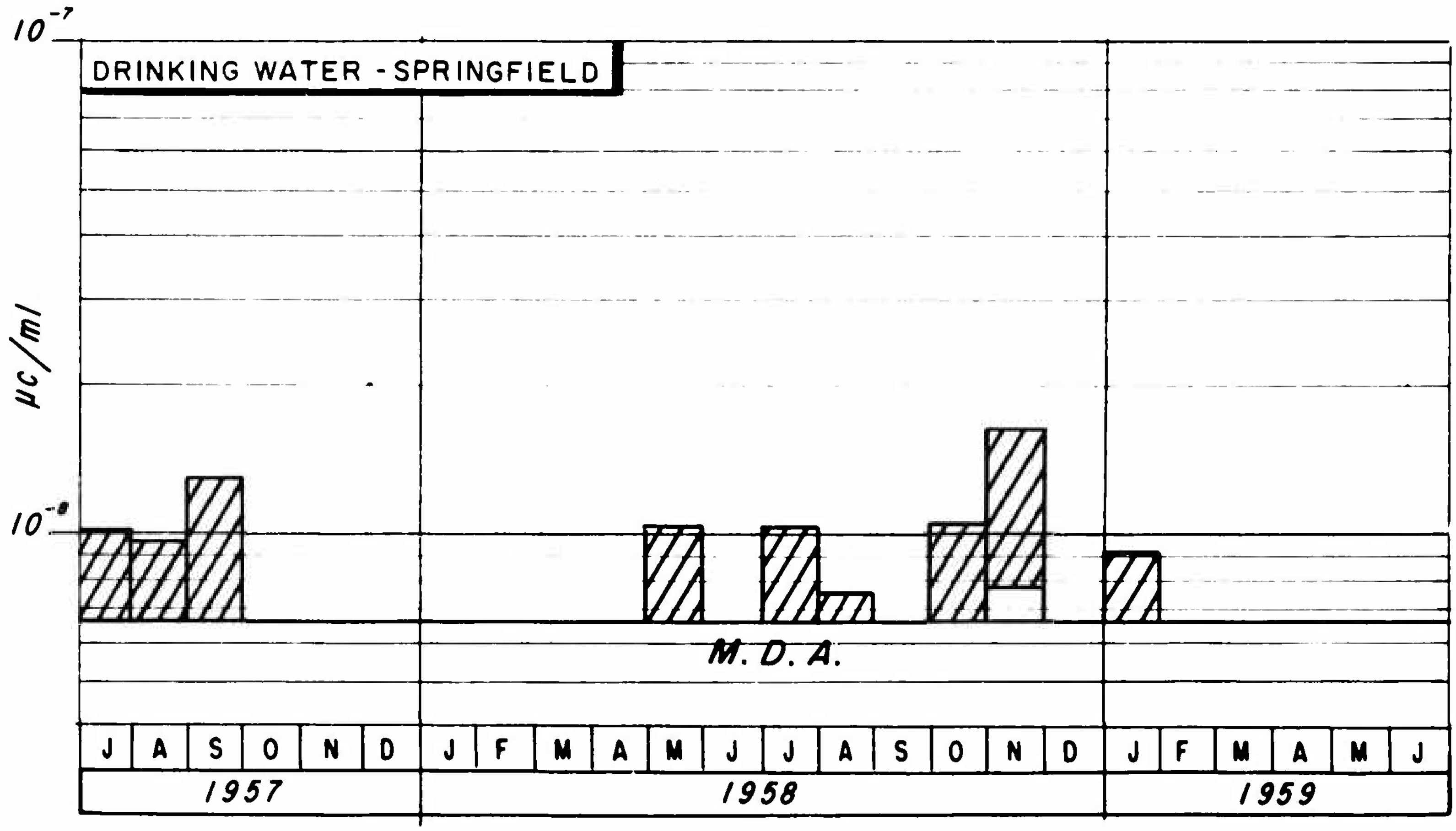

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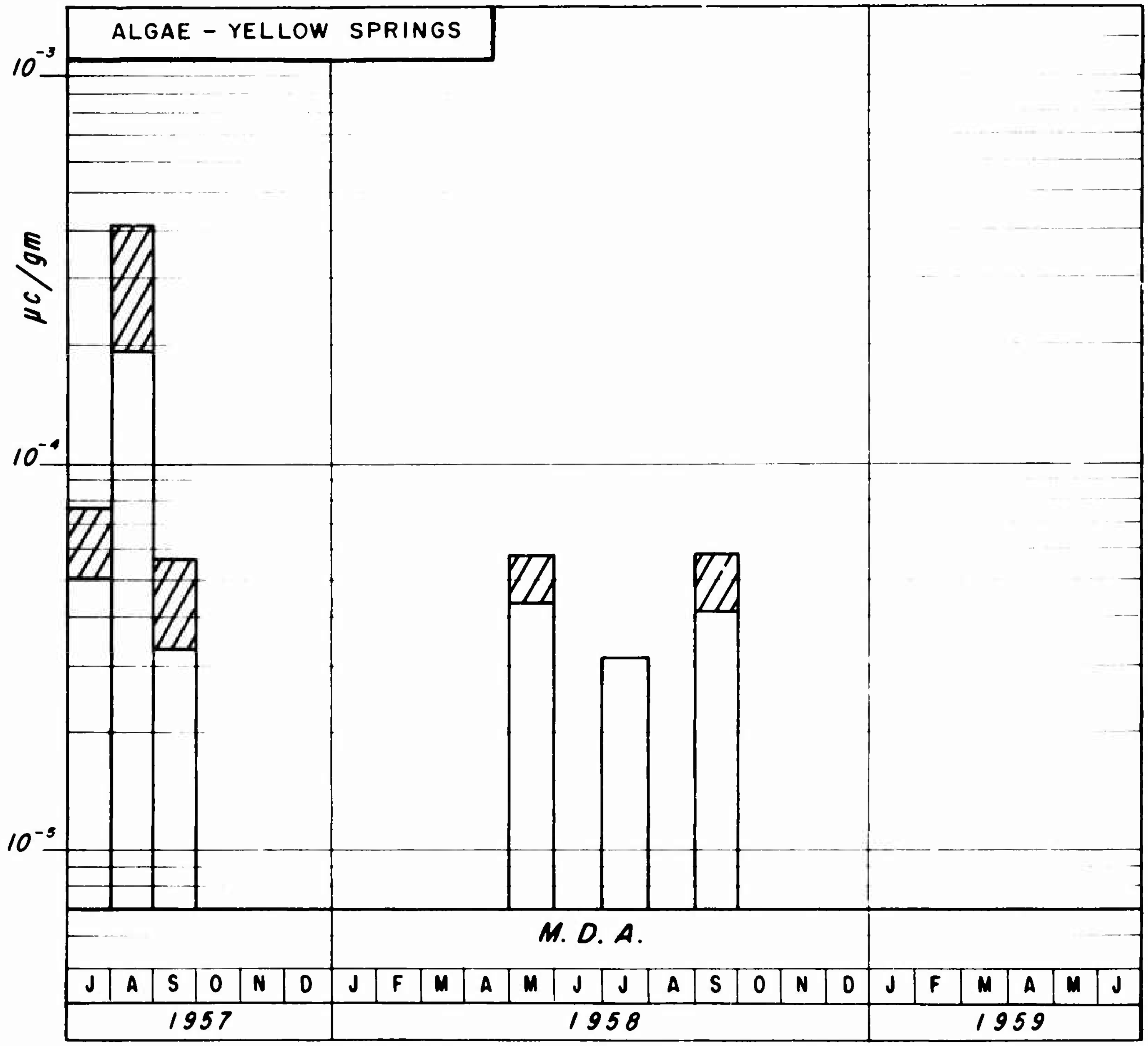

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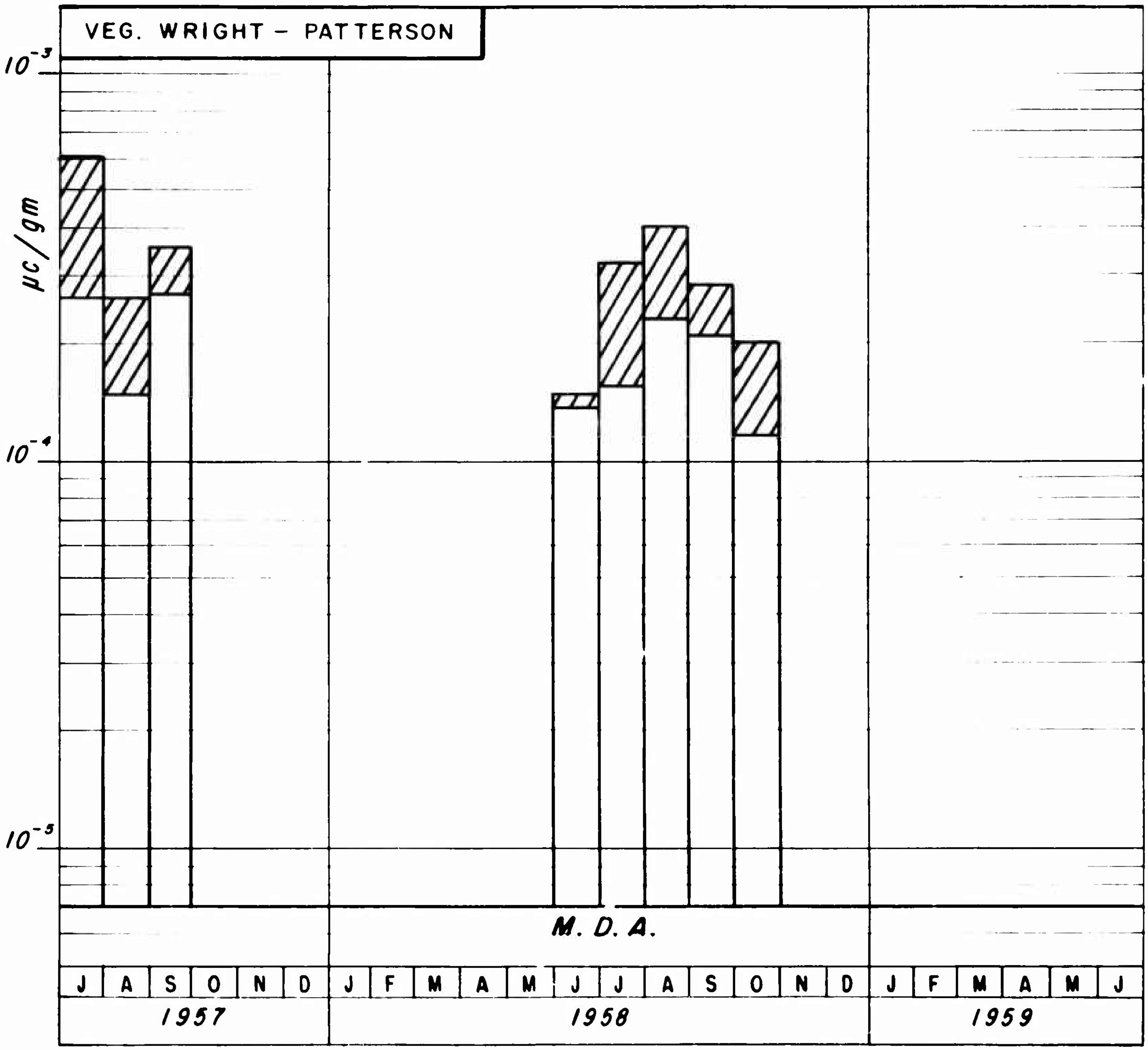

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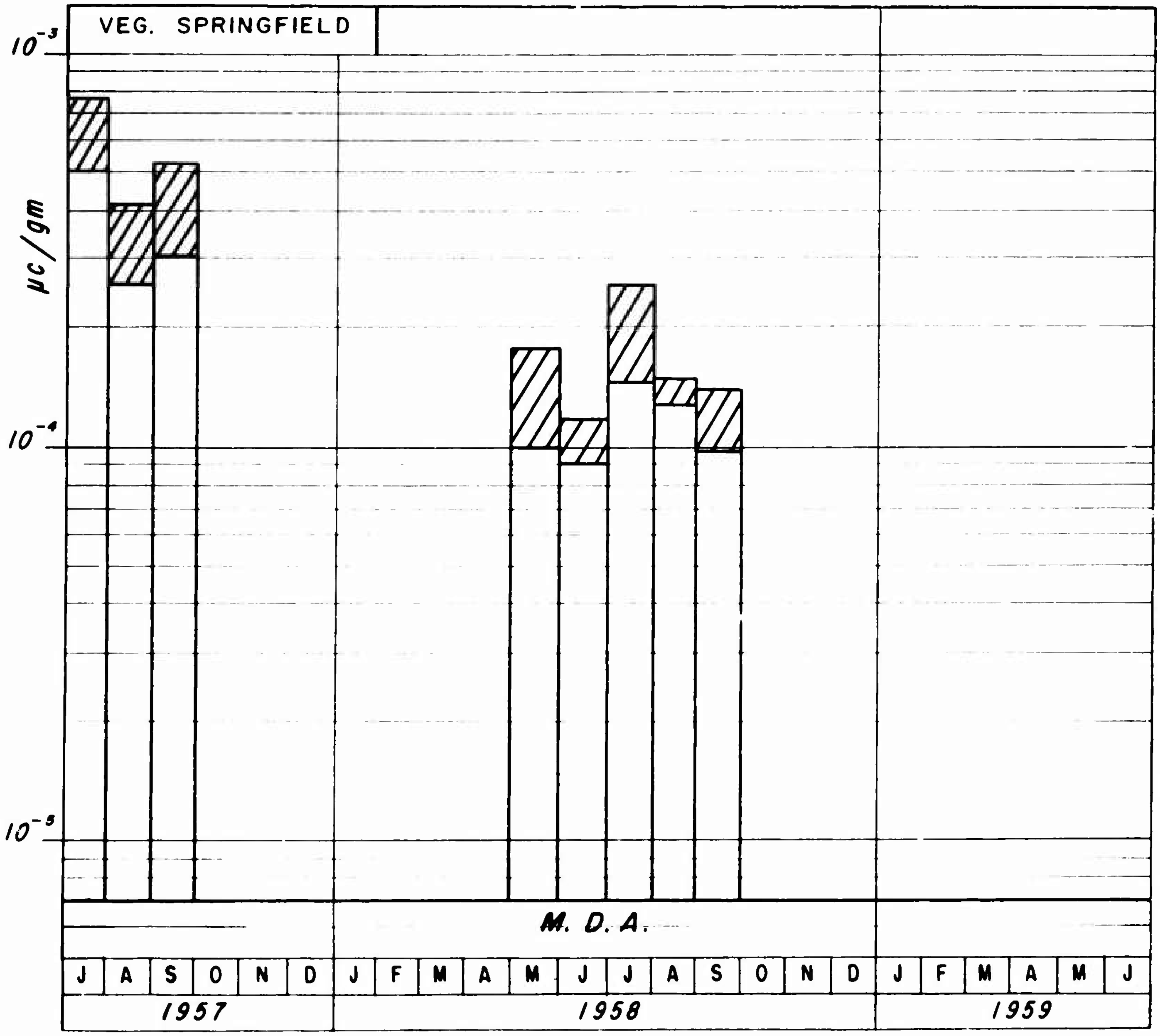

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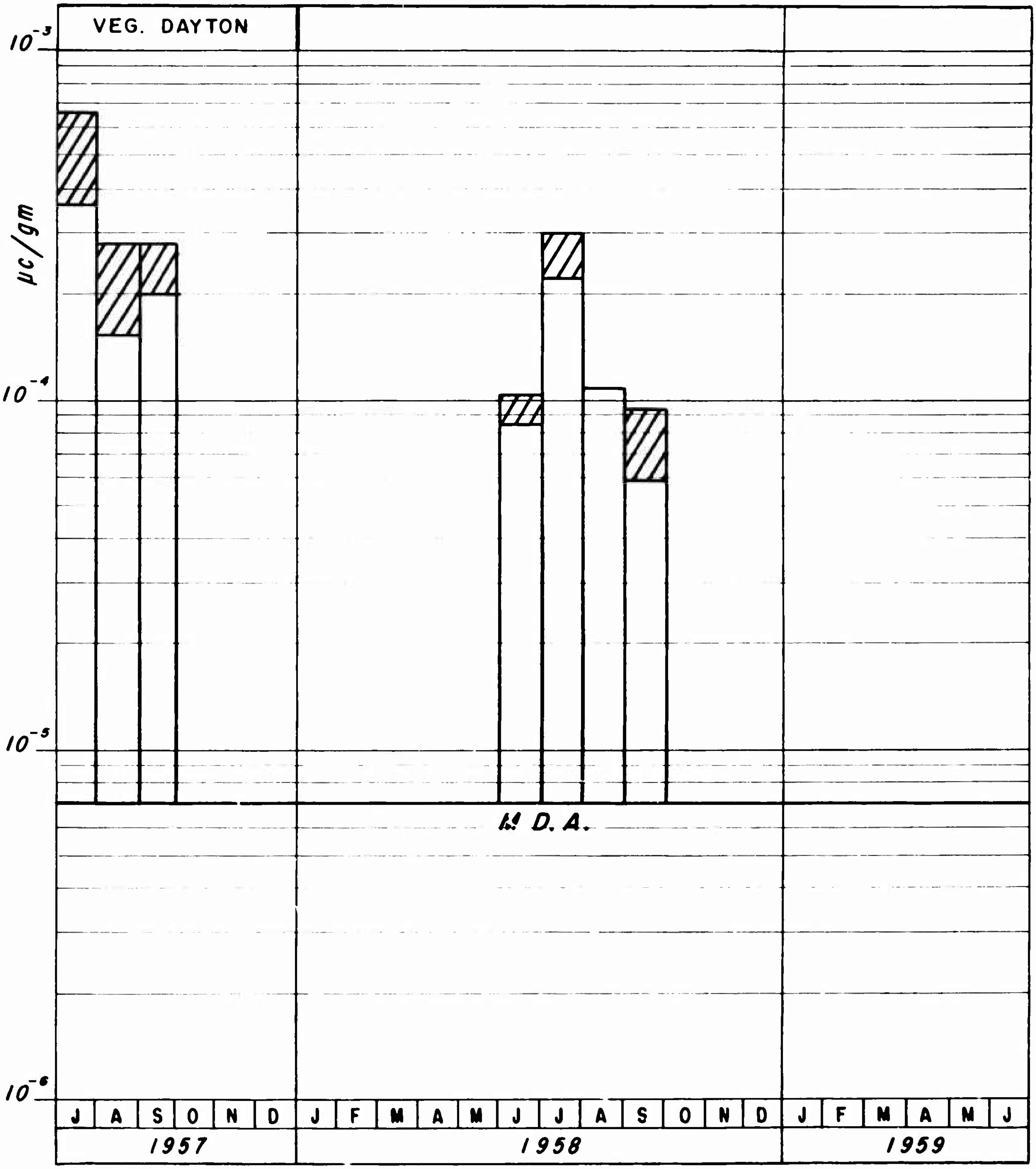

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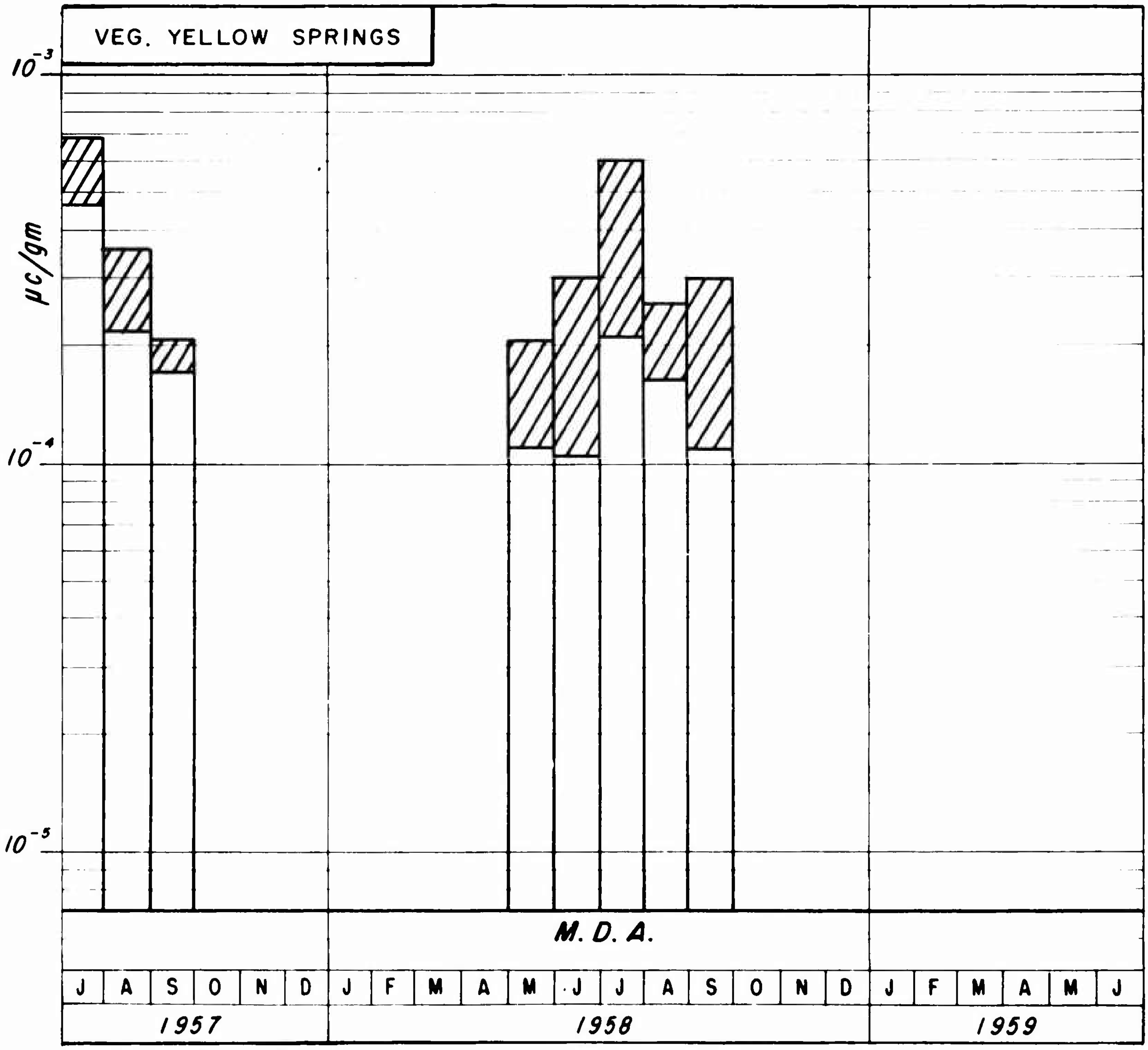

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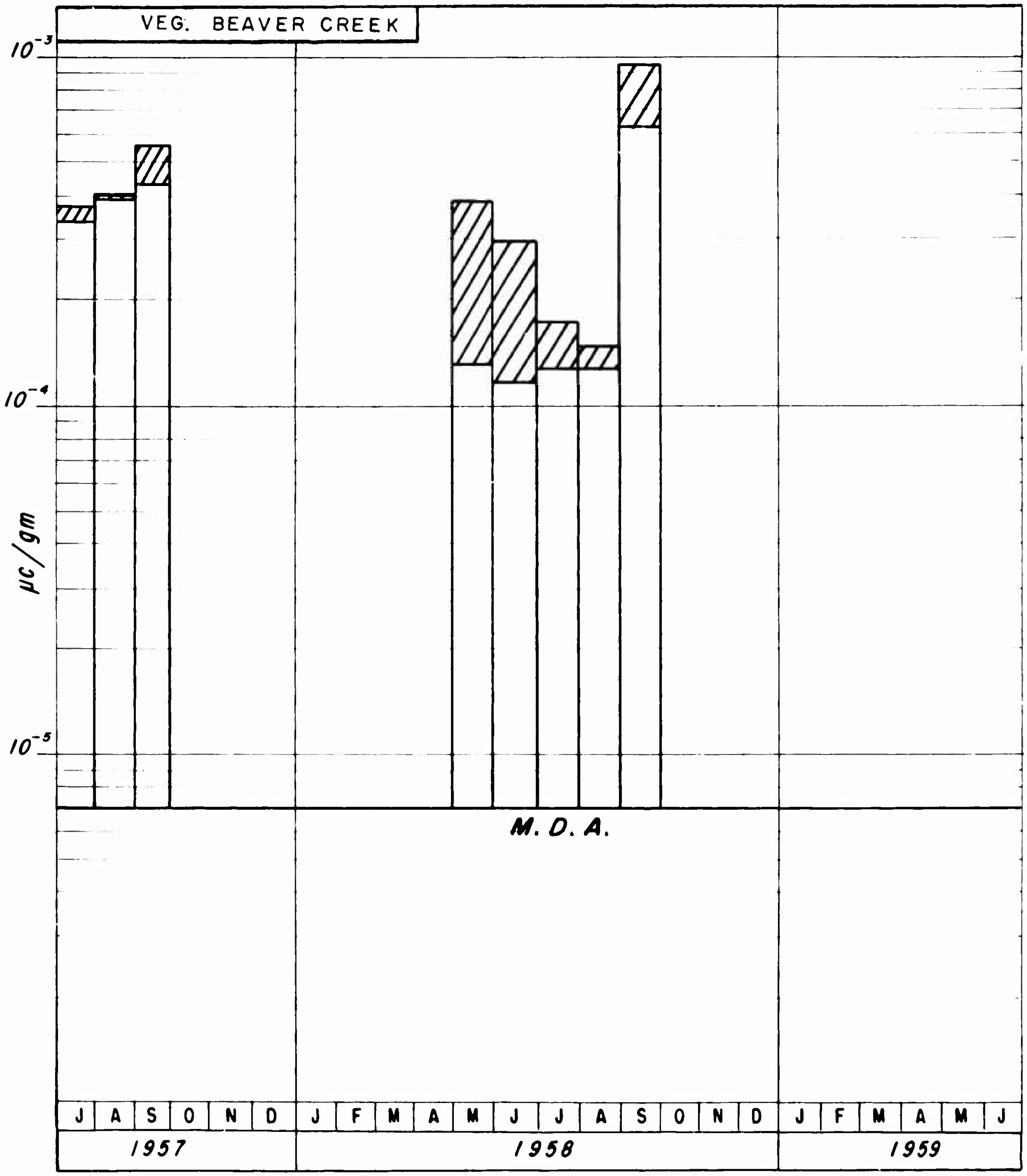

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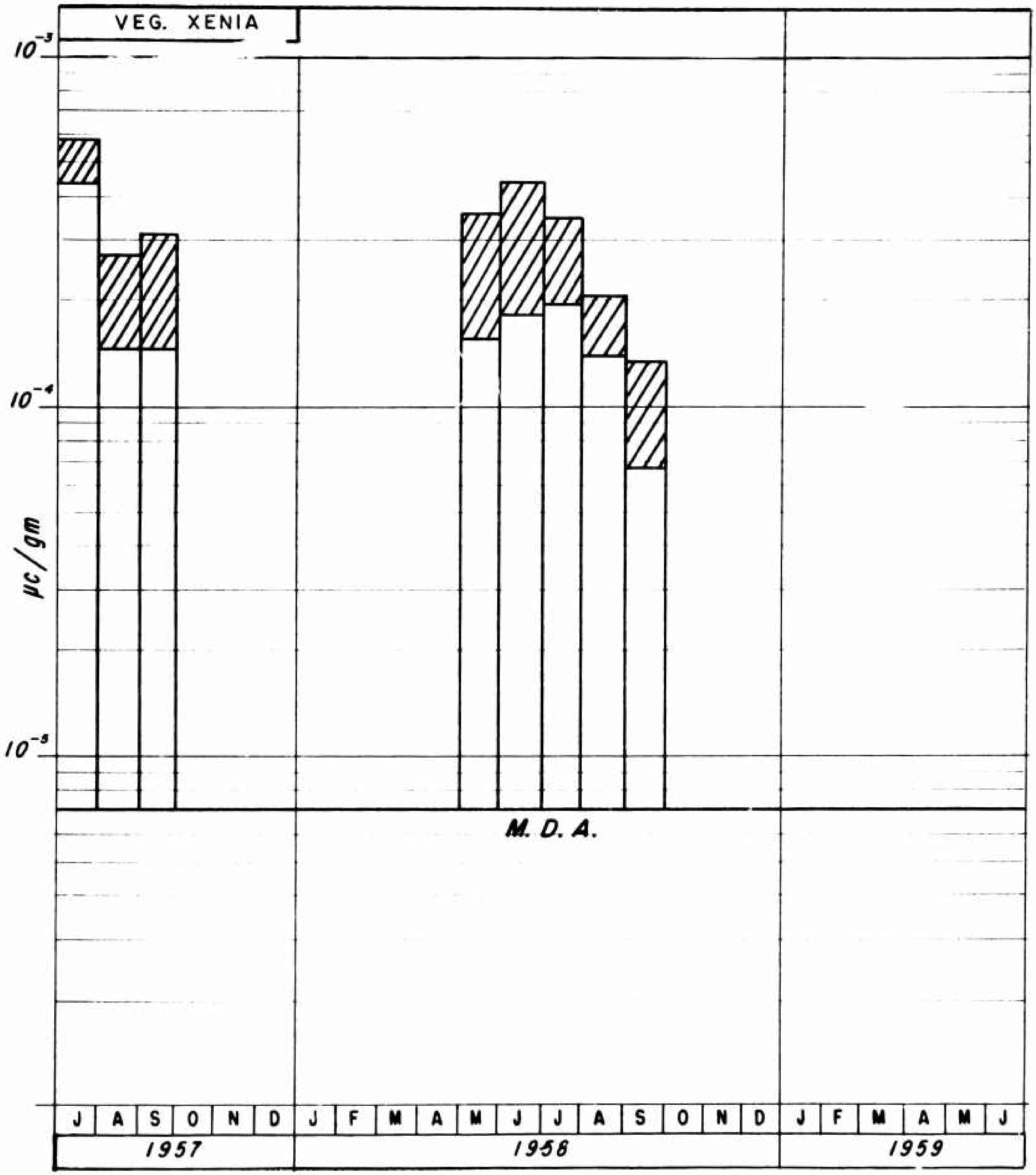

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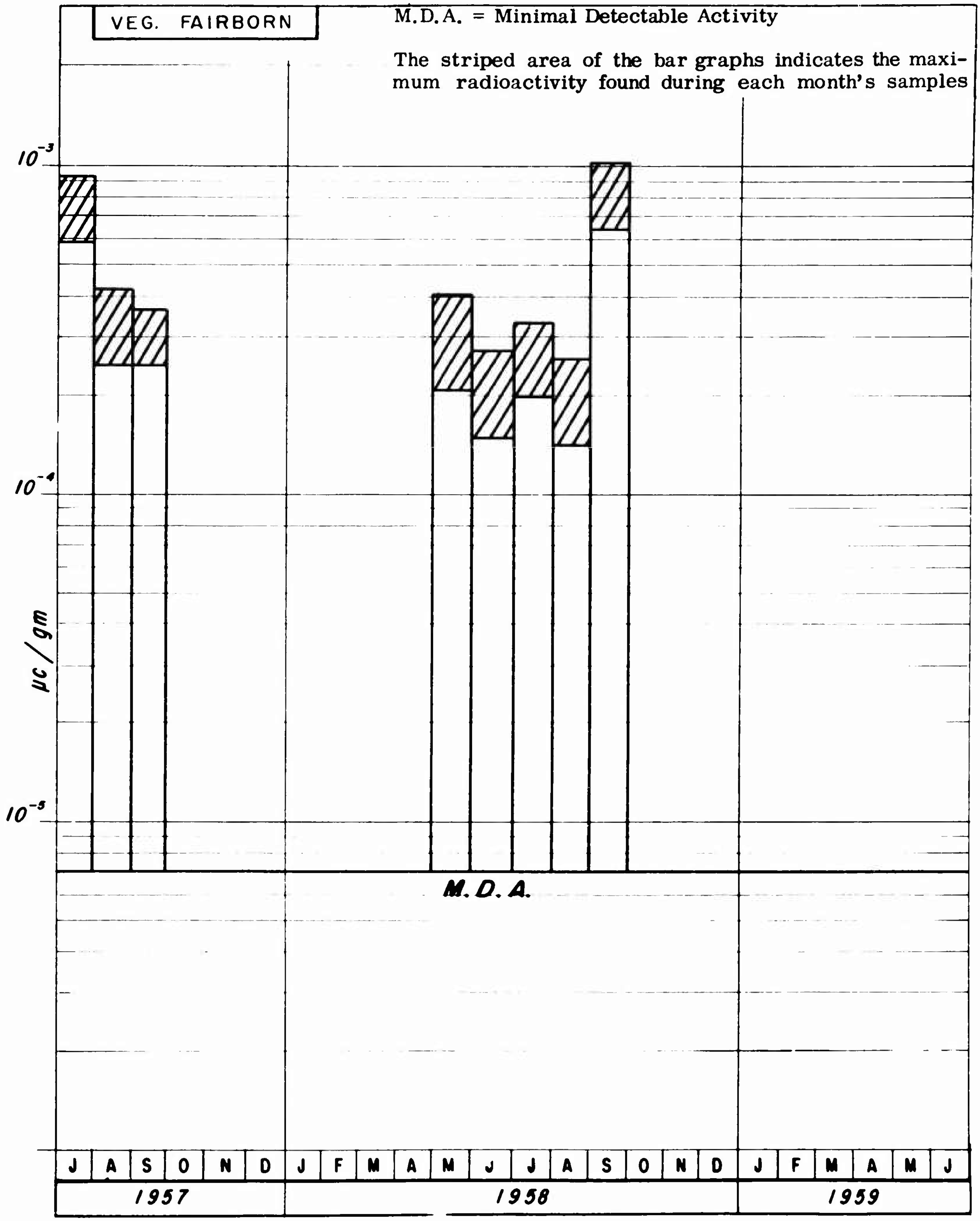
VEG. FAIRBORN
M.D.A. = Minimal Detectable Activity
The striped area of the bar graphs indicates the maximum radioactivity found during each month's samples
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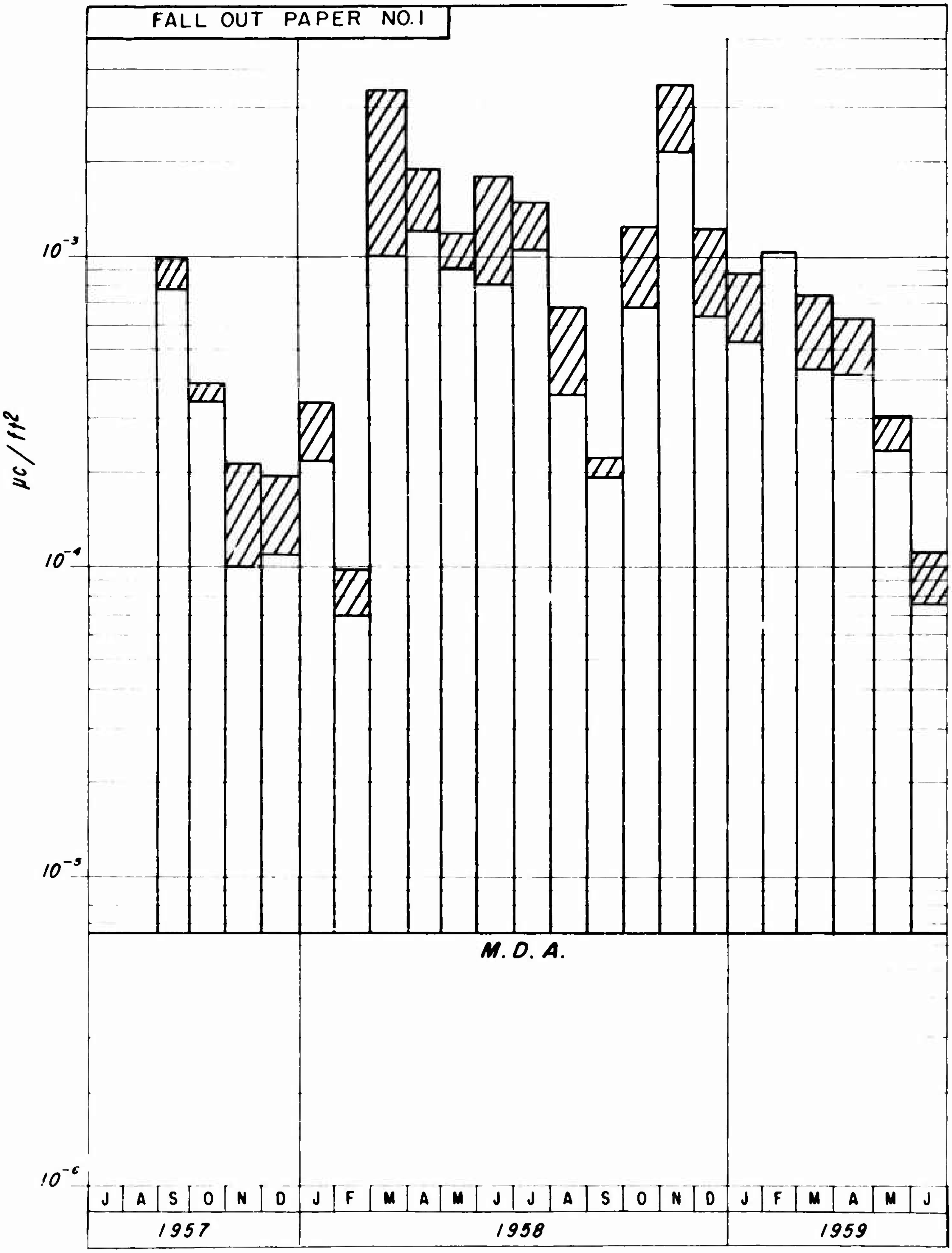

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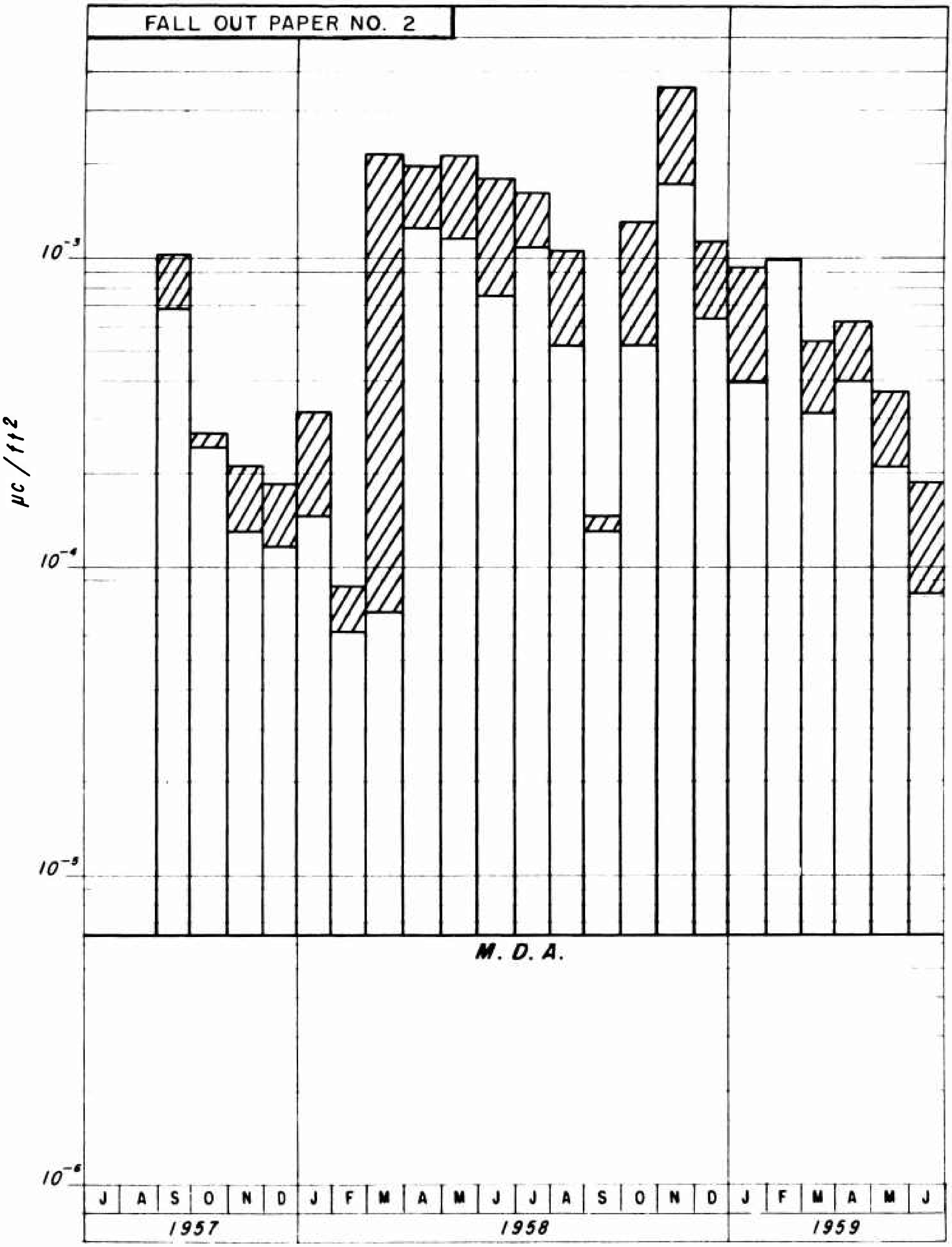

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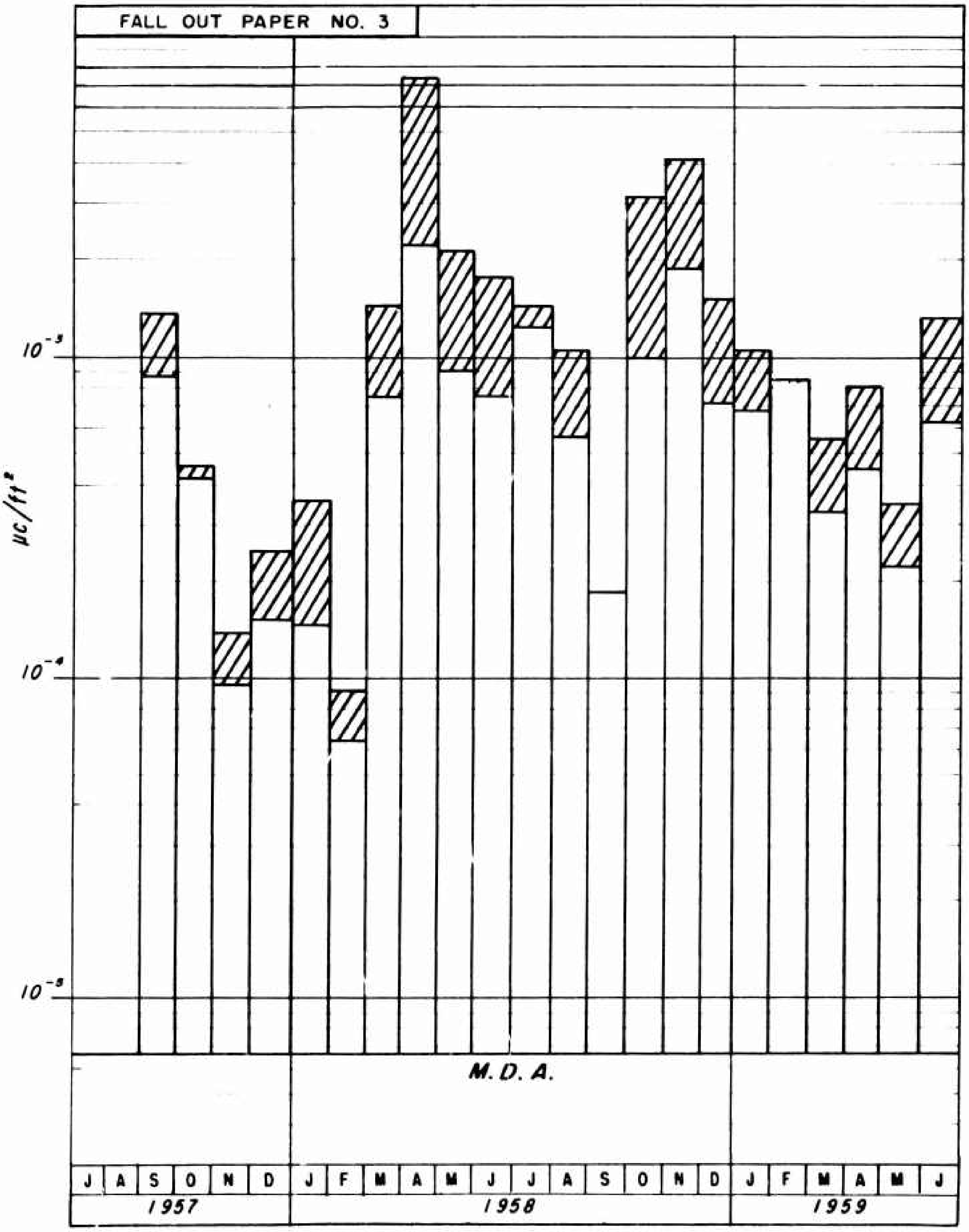

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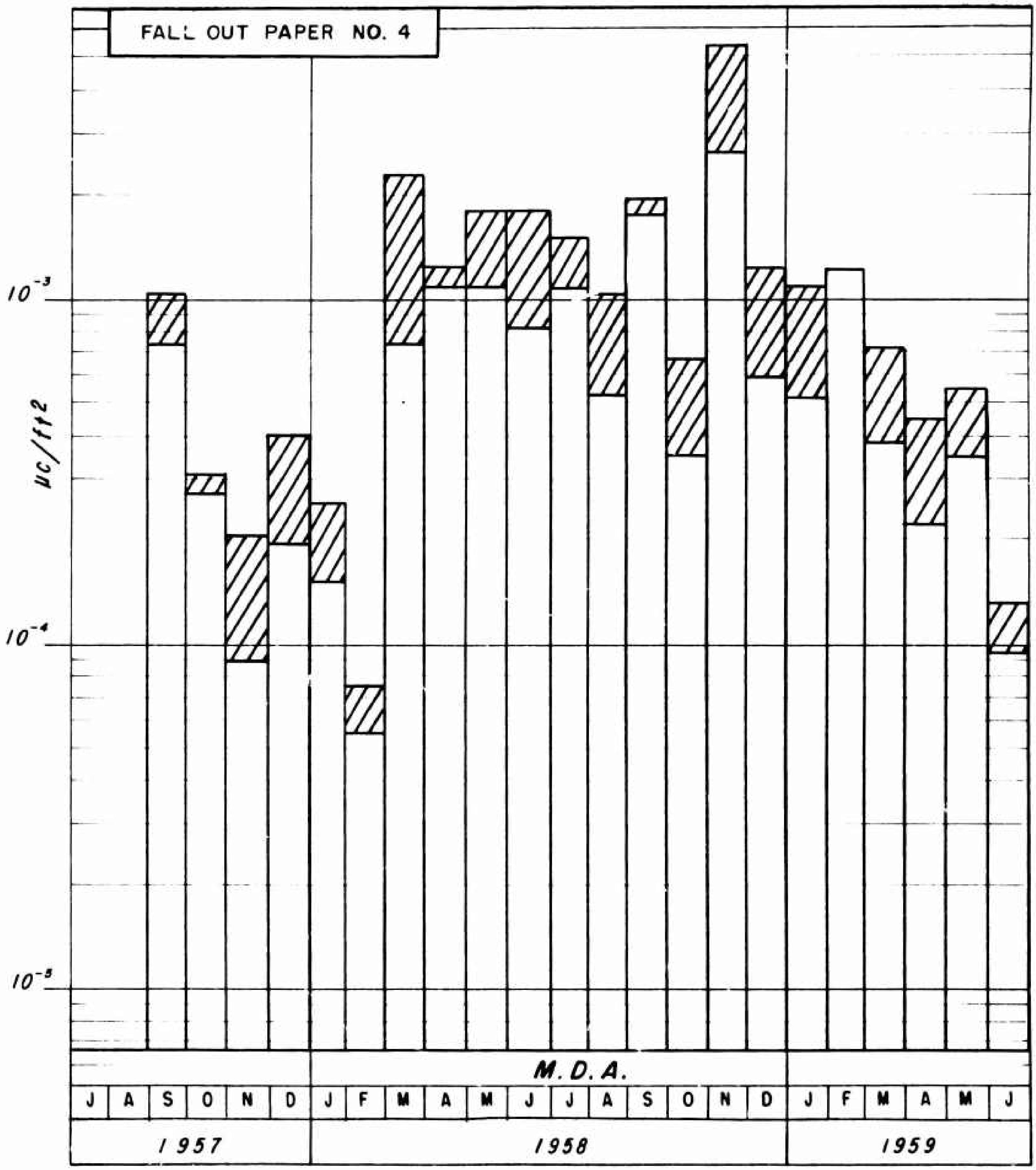

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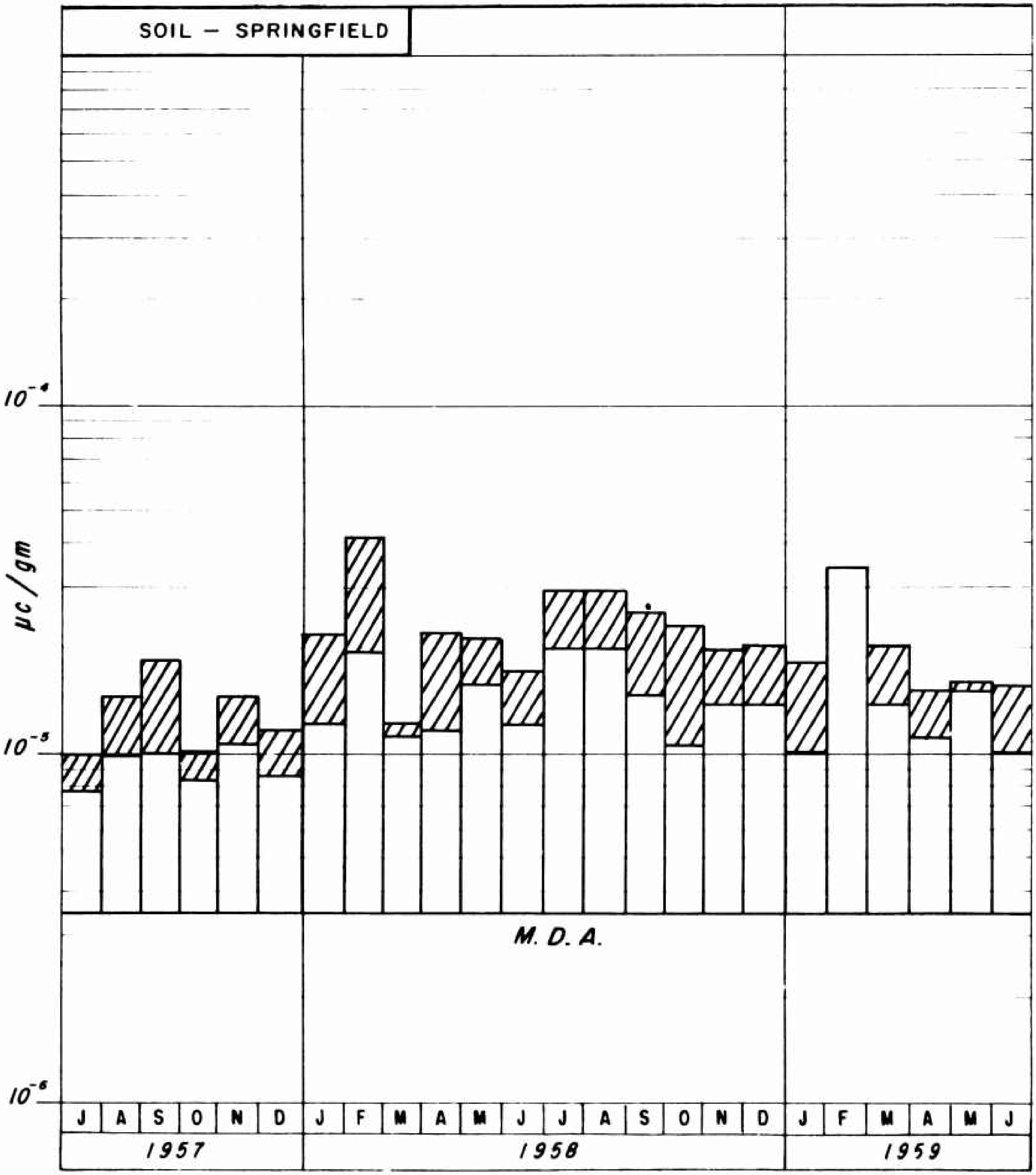

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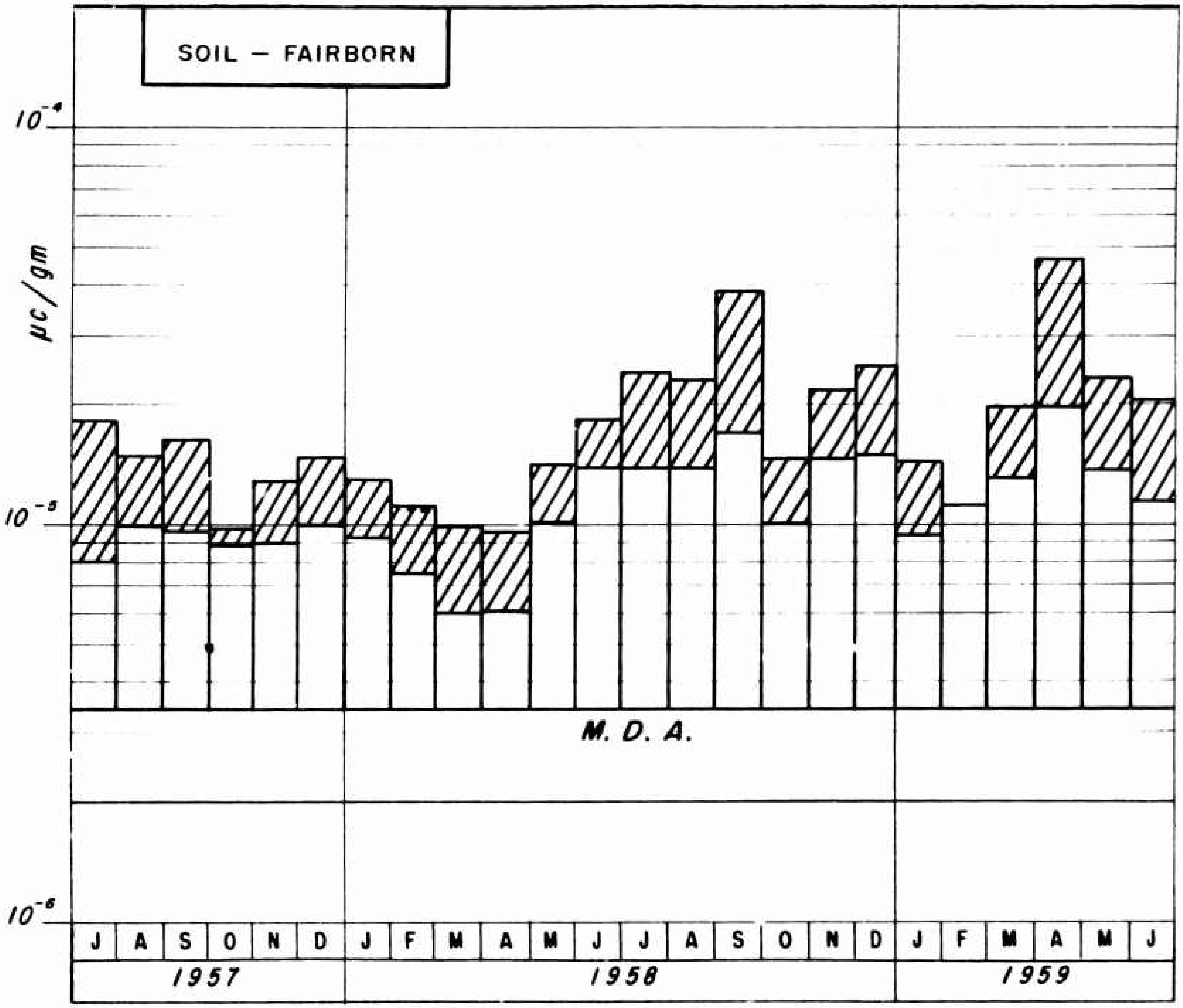

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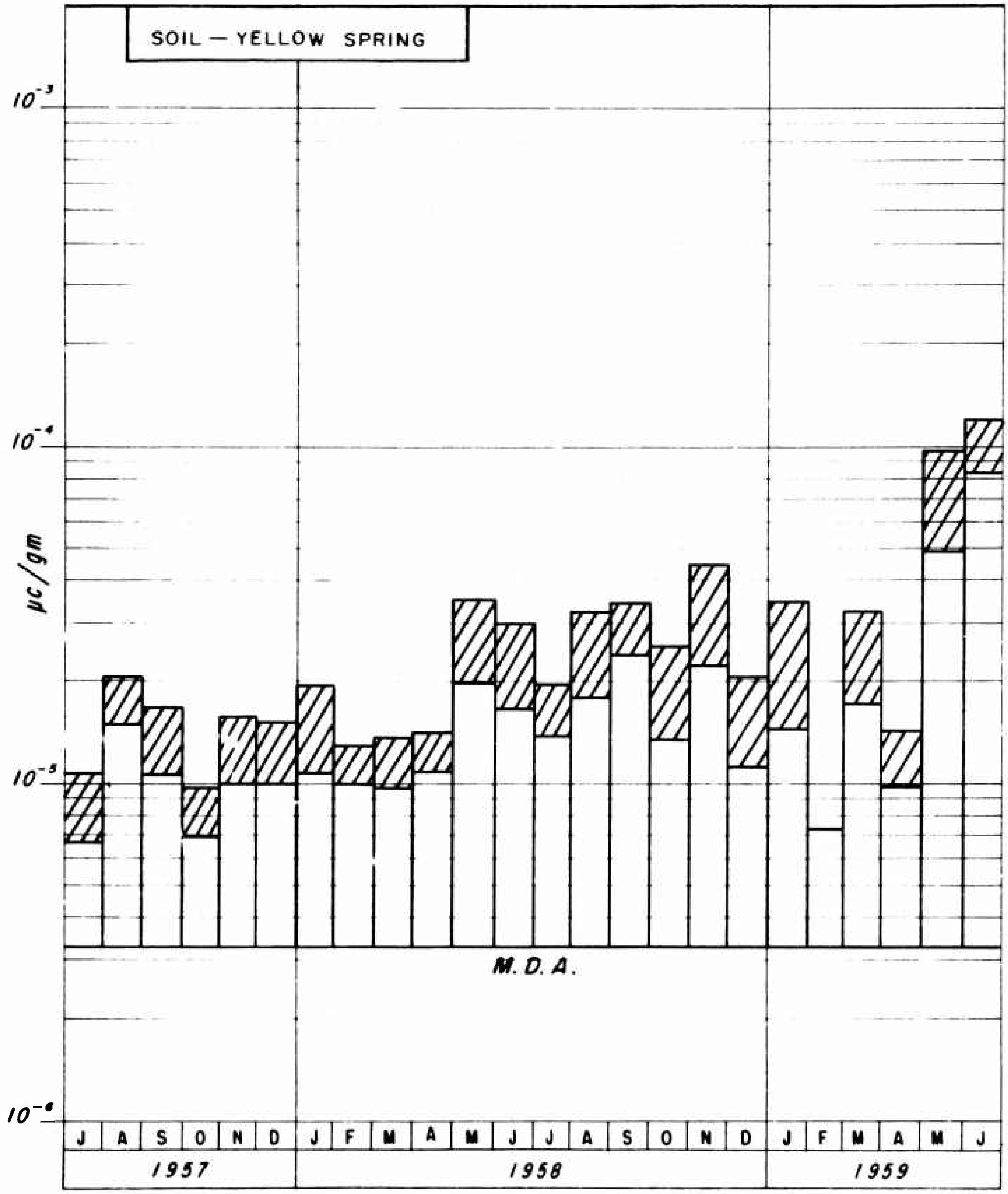

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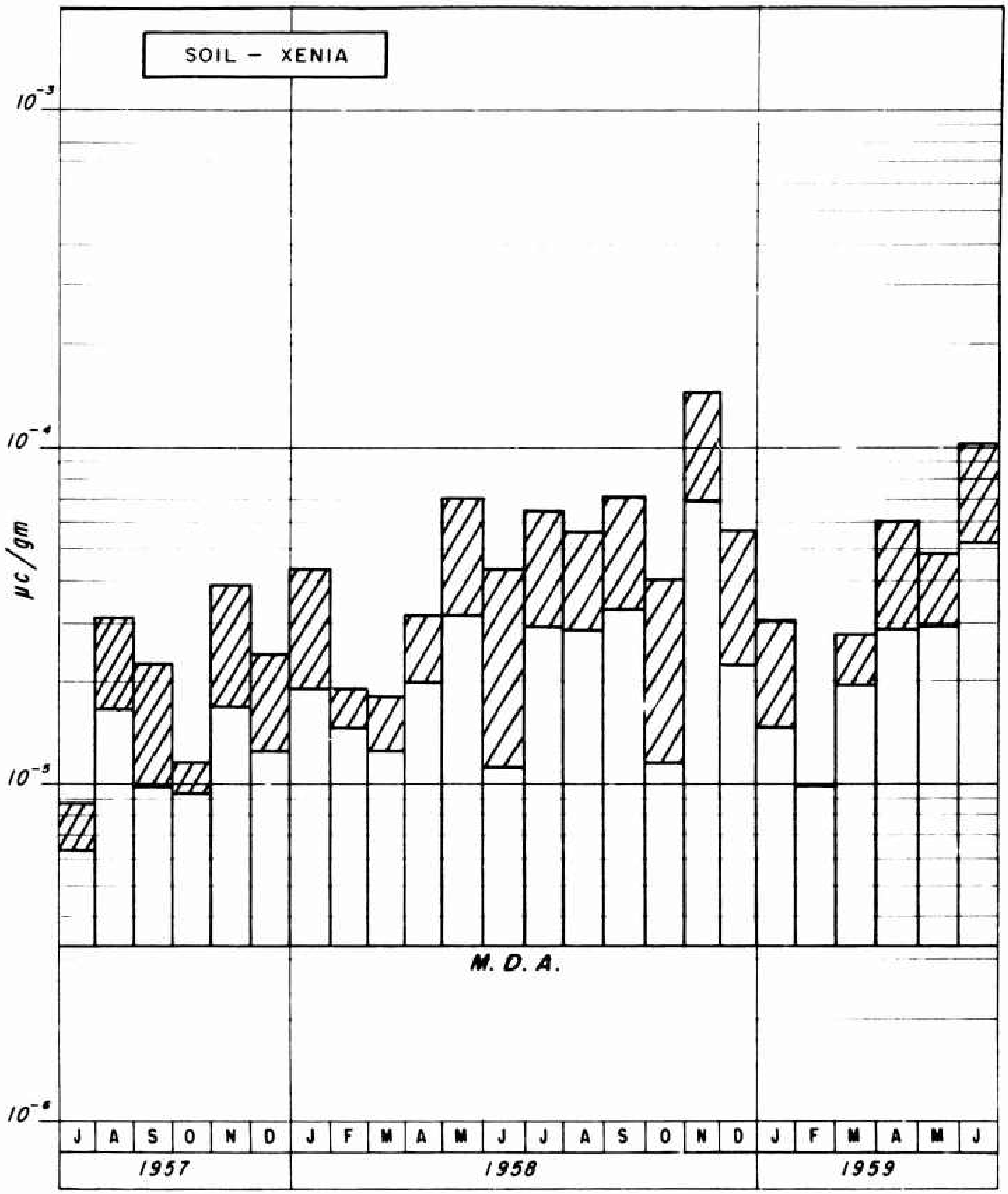

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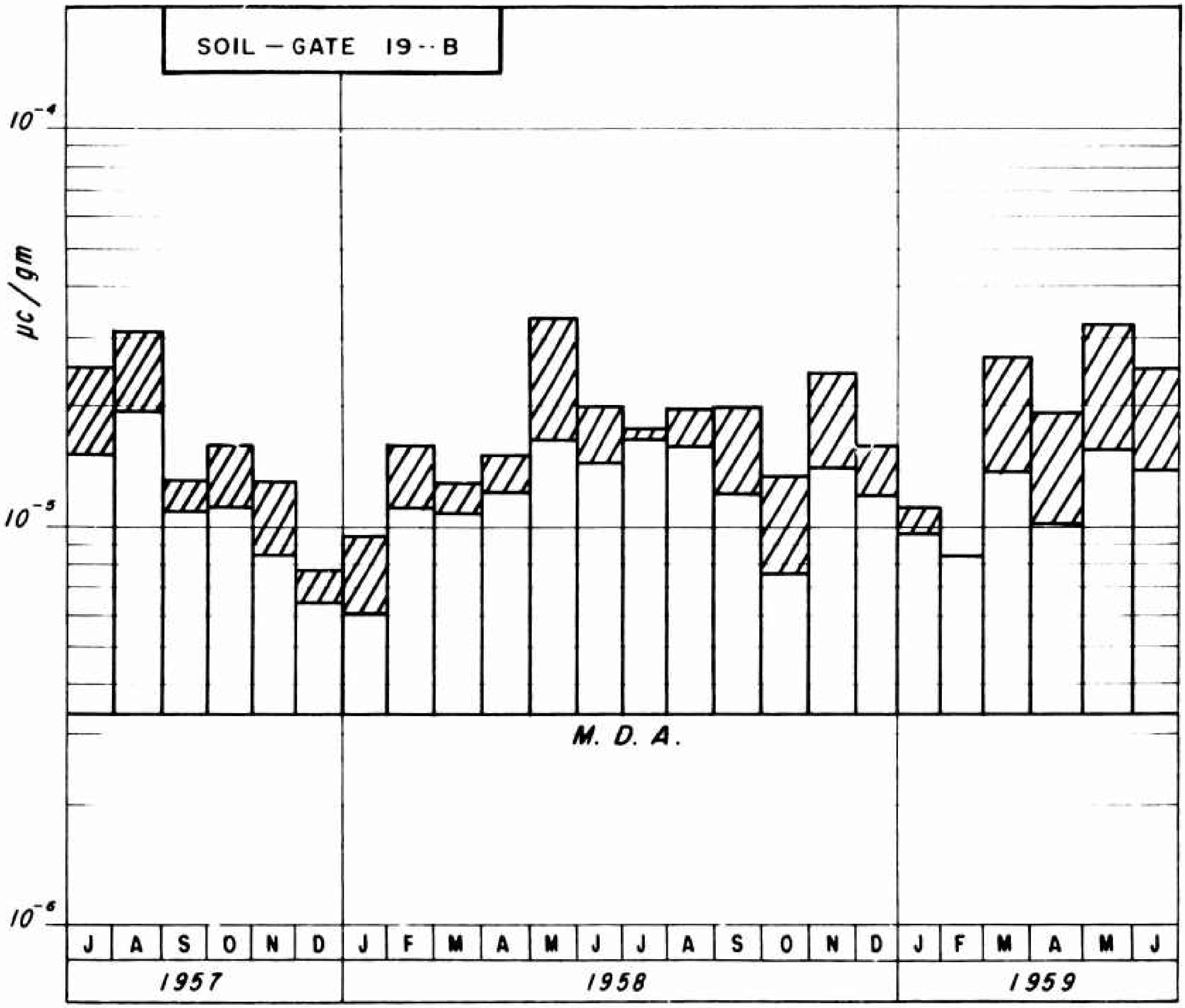

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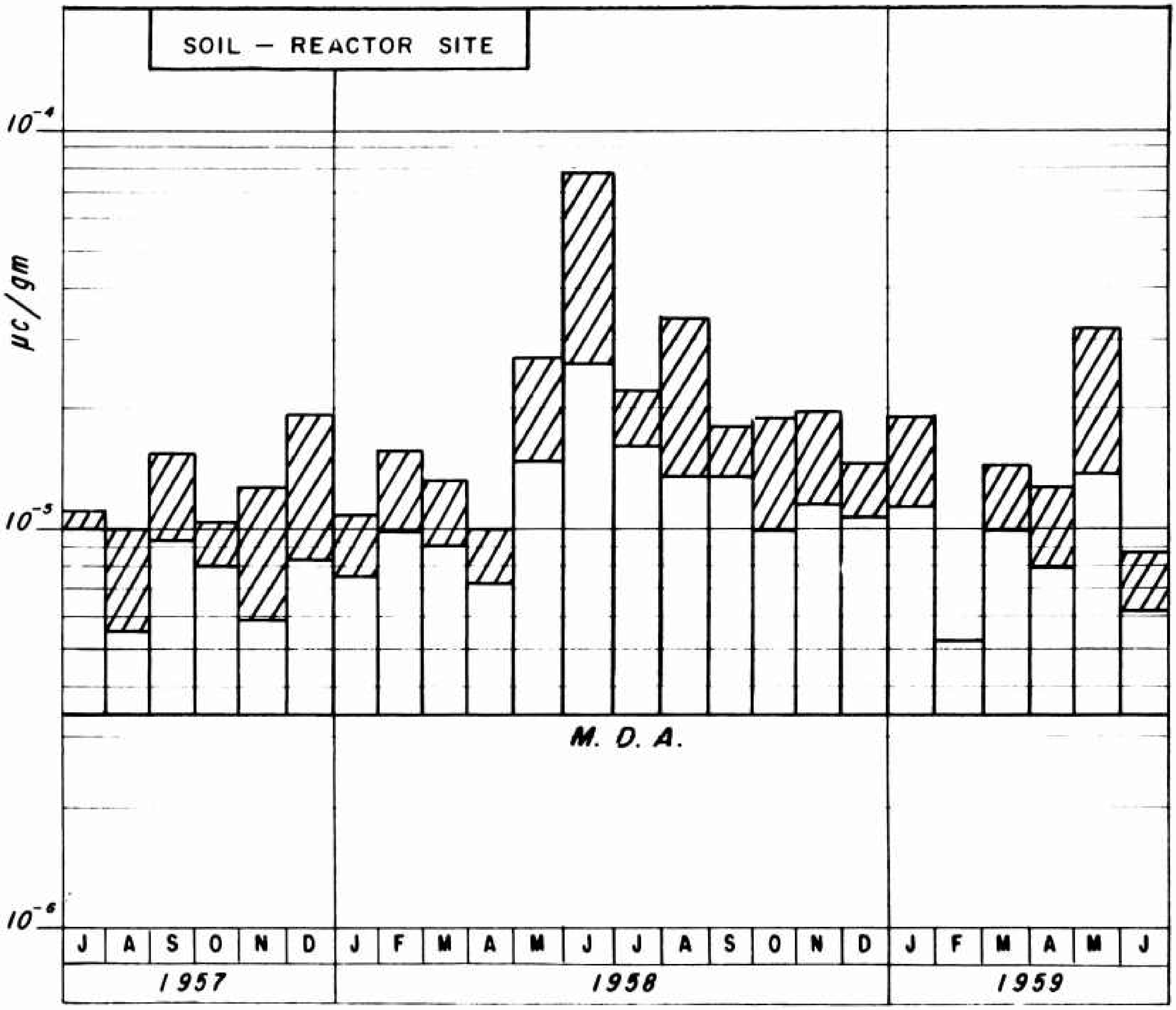

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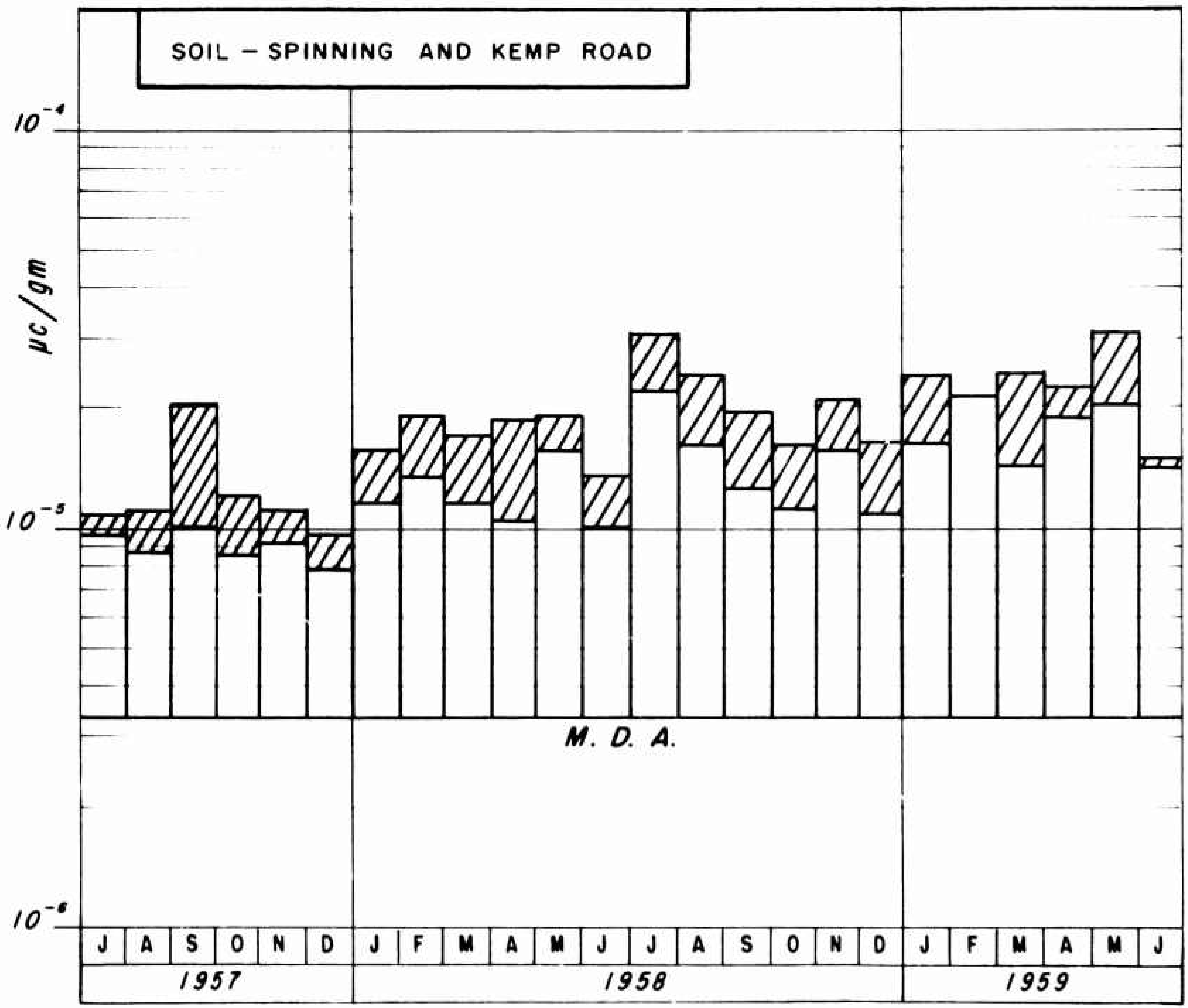
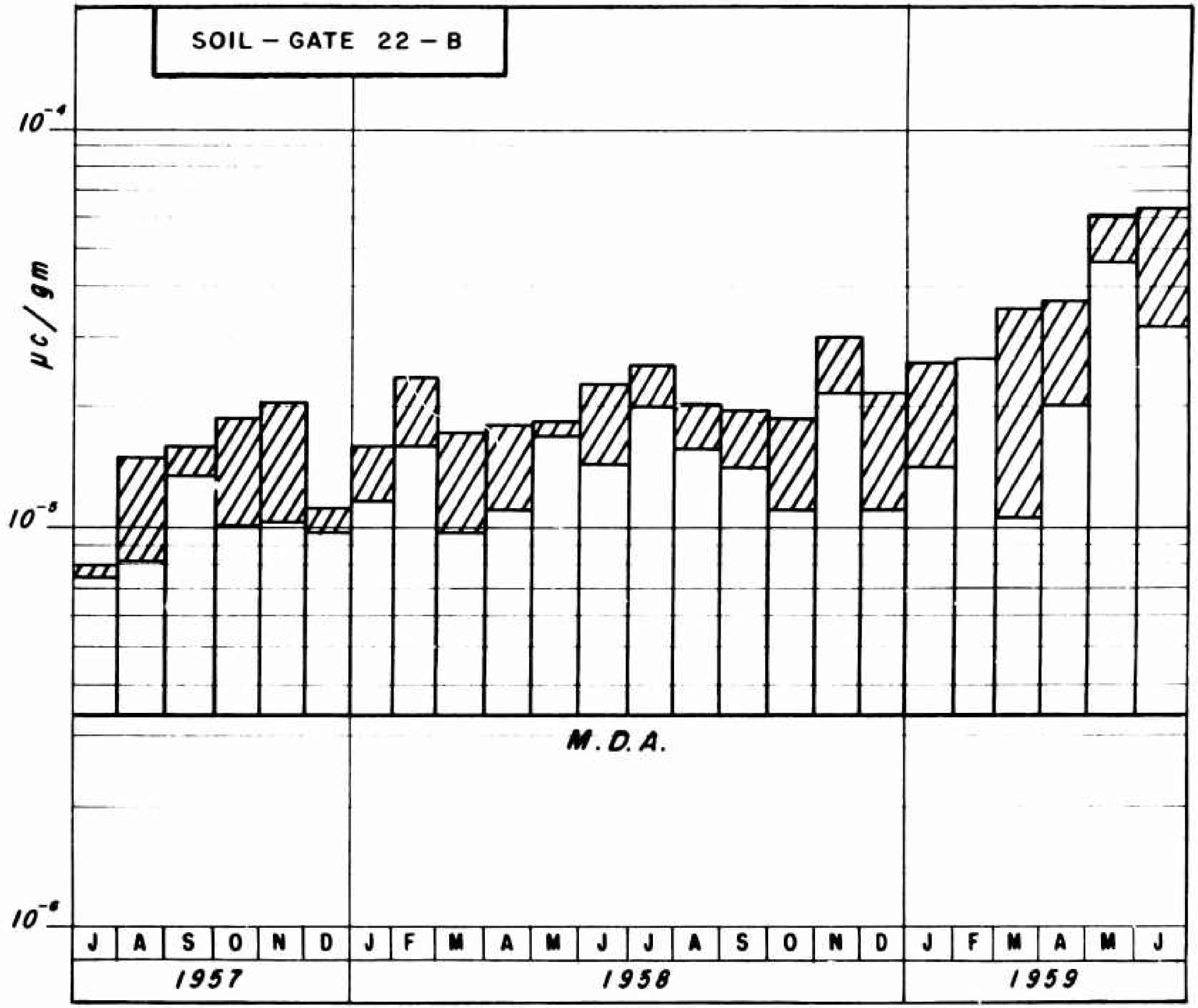


M.D.A. = Minimal Detectable Activity

The striped area of the bar graphs indicates the maximum radioactivity found during each month's samples



M.D.A. = Minimal Detectable Activity

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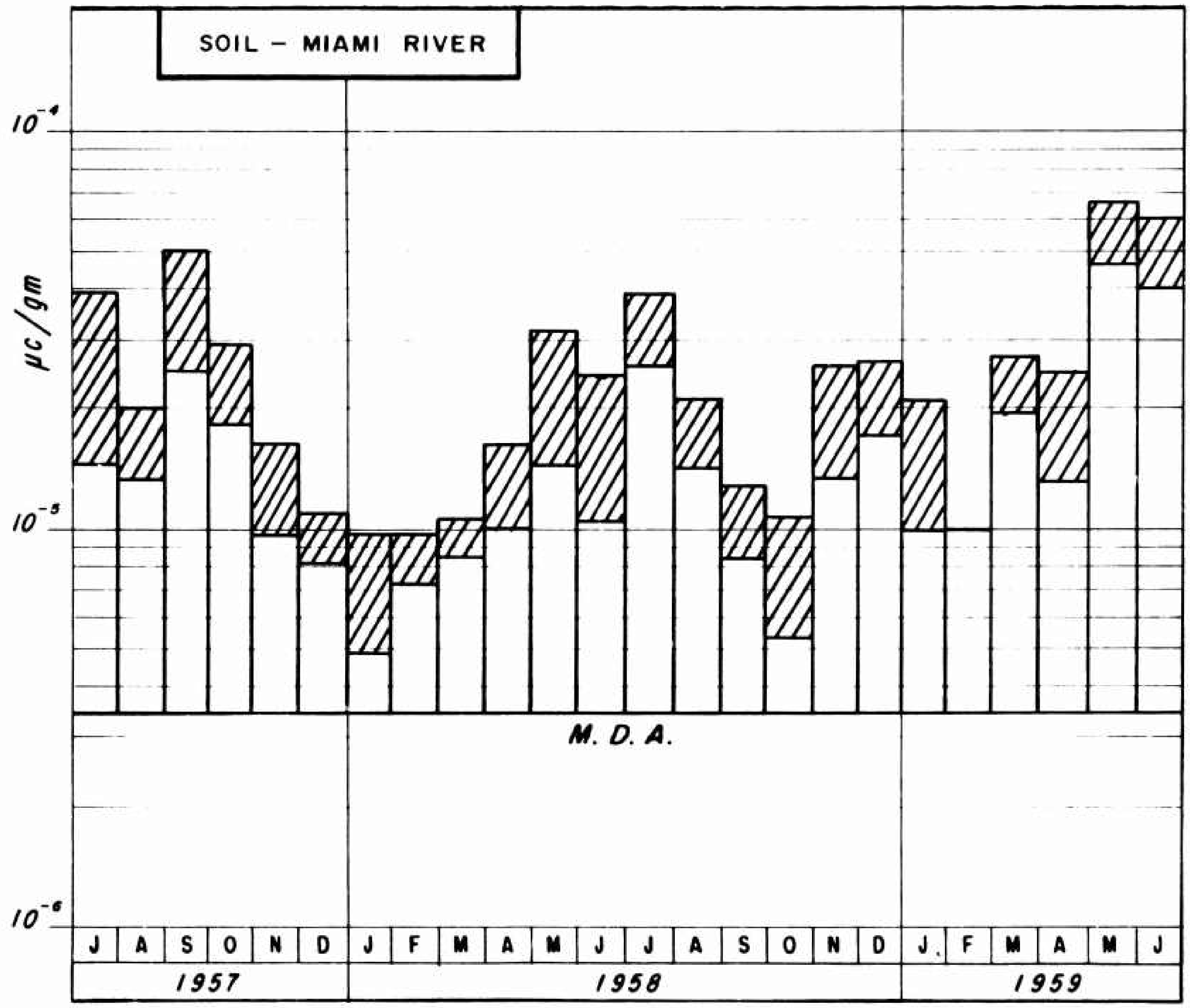

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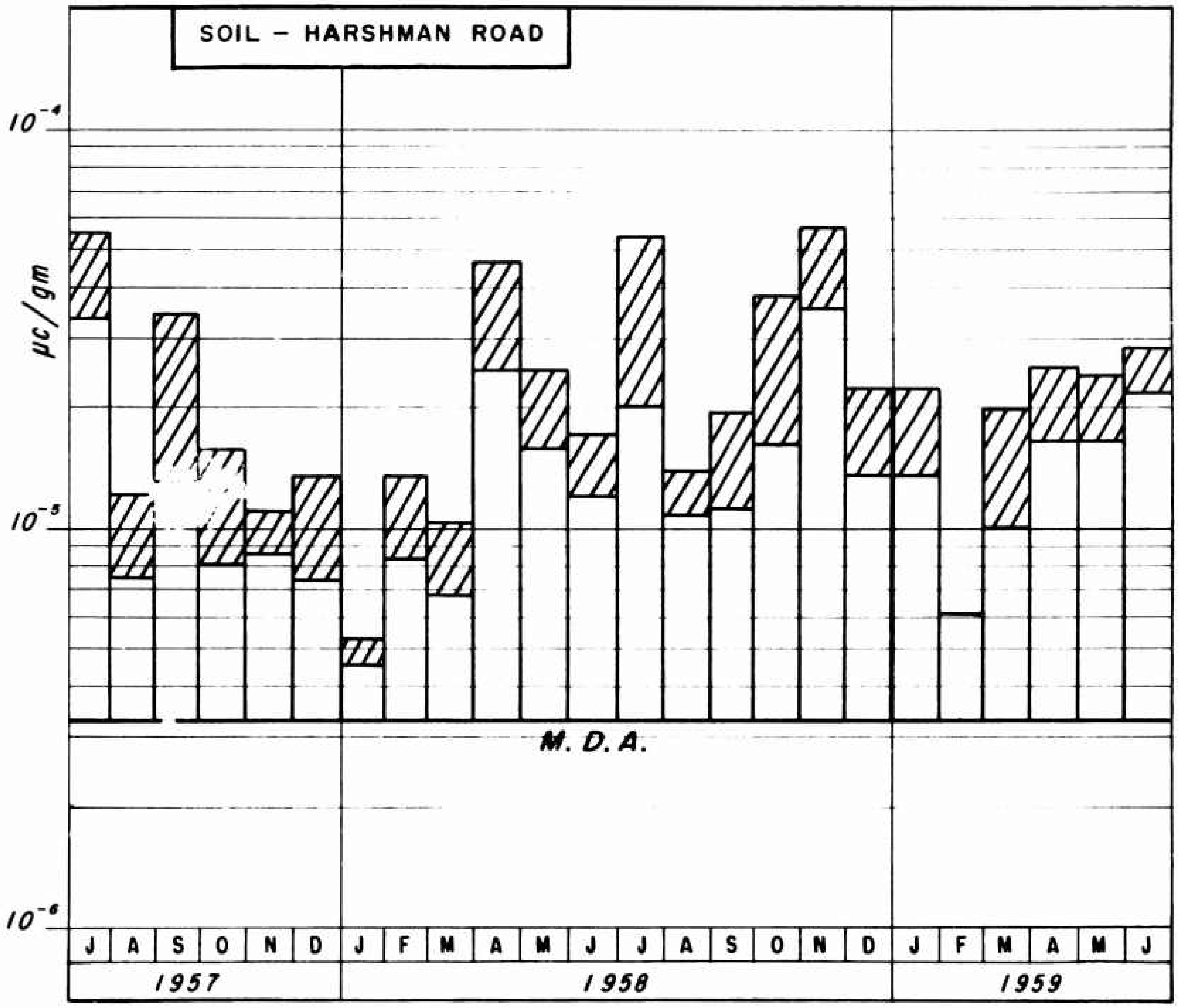

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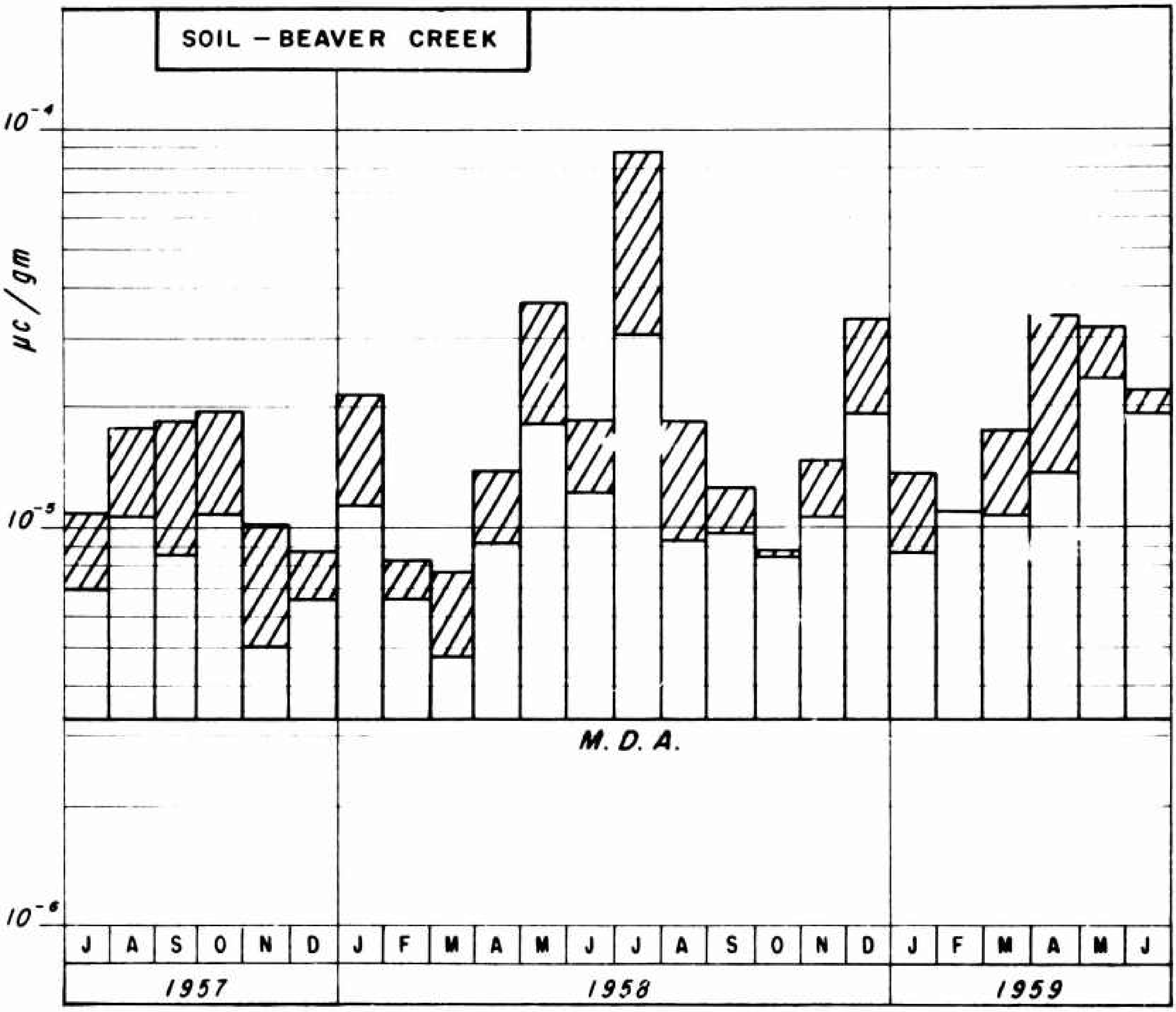

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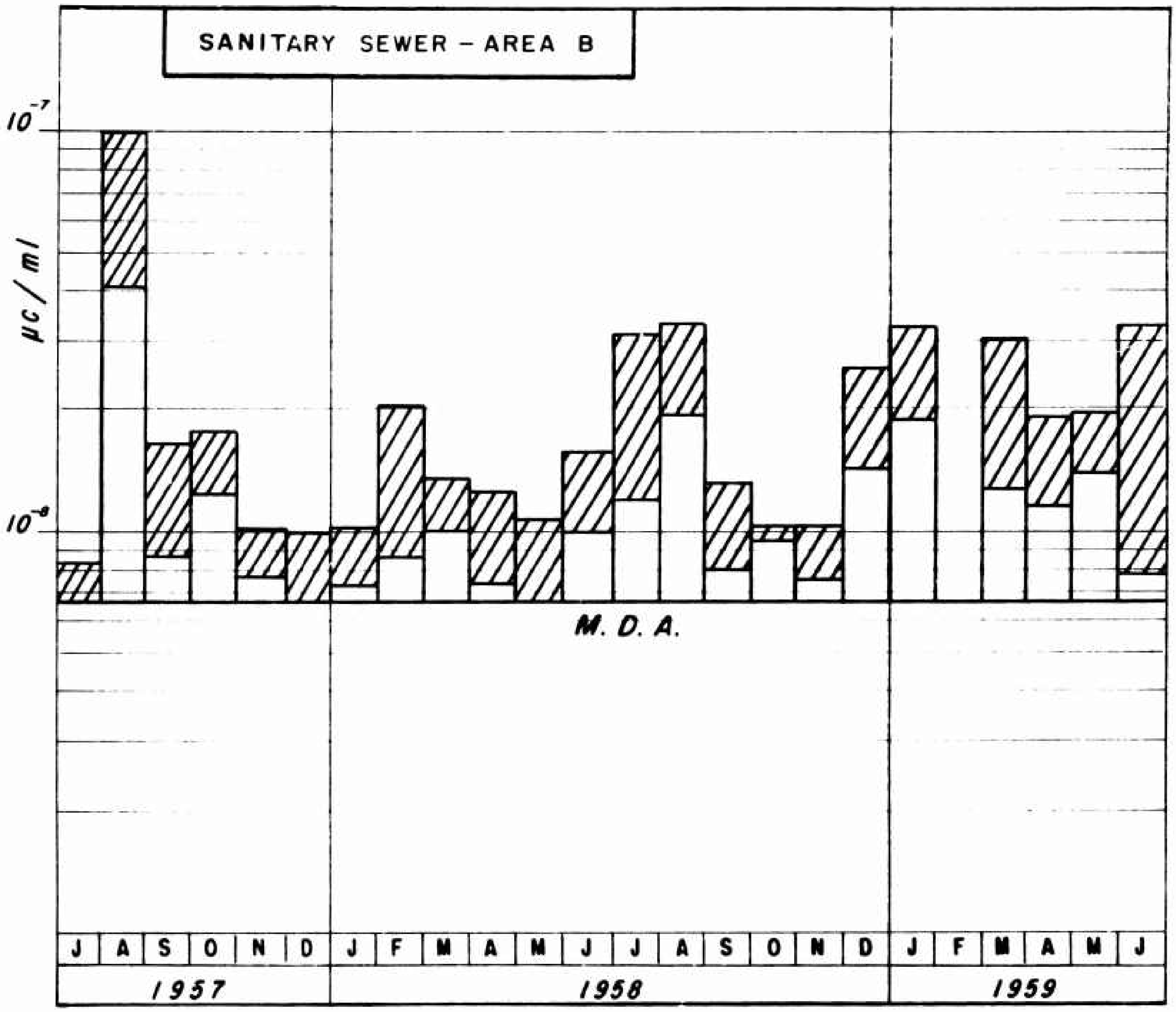

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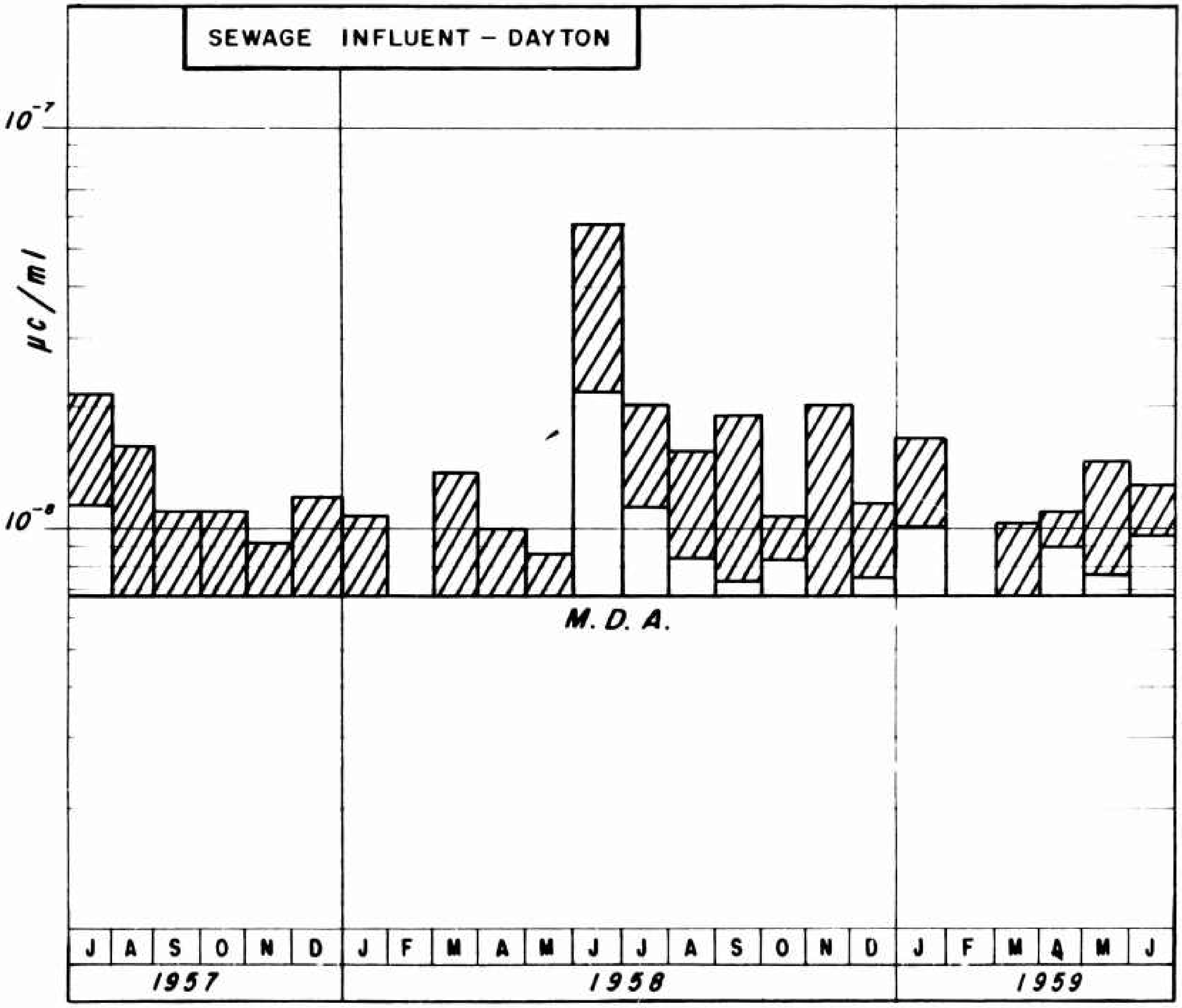

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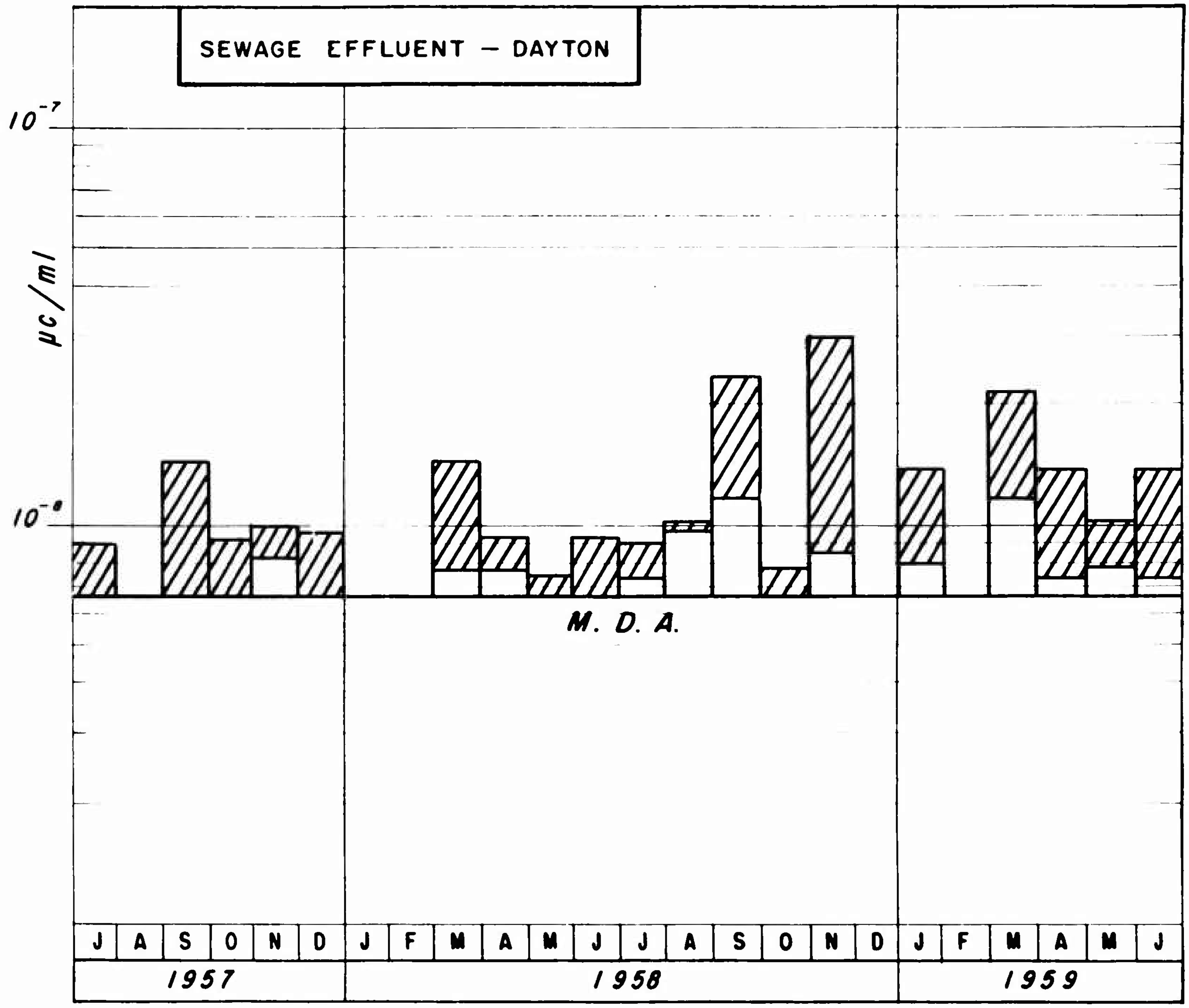
The striped area of the bar graphs indicates the maximum radioactivity found during each month's samples



M.D.A. = Minimal Detectable Activity

The striped area of the bar graphs indicates the maximum radioactivity found during each month's samples

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APPENDIX II

LOW-LEVEL RADIOACTIVITY MEASUREMENTS OF SITE SURVEY SAMPLES

Symbols

The following is a key to the code used for samples in the report from Nuclear Science and Engineering Corporation on Low-Level Radioactivity Measurements of Site Survey Samples, presented as Appendix II.

SAMPLE CODE	SAMPLE AREA
Soil	
S-1	Wright-Patterson Air Force Base
S-7	Fairborn
S-8	Springfield
S-9	Xenia
S-10	Yellow Springs
S-11	Dayton
Water	
W-3	Rohers Island (river)
W-10	Dayton Drinking Water
W-11	Fairborn Drinking Water
W-12	Springfield Drinking Water
W-13	Wright-Patterson Air Force Base
W-16	Xenia Drinking Water
W-17	Yellow Springs Drinking Water
Vegetation	
D	Dayton Area
F	Fairborn Area
S	Springfield Area
W	Wright-Patterson Air Force Base
X	Xenia Area
Y	Yellow Springs Area

Symbols (Cont'd)

SAMPLE CODE	SAMPLE AREA
Milk	
517	Farm Area North of Dayton
823	Farm Area South of Dayton
844	Farm Area East of Dayton

A. INTRODUCTION

Nuclear Science and Engineering Corporation has performed the quantitative radioactivity analyses reported herein for the Research and Technology Division, Wright-Patterson Air Force Base, Ohio, under contract AF 33(616)-5909 as proposed under NSEC No. 30-32-8015.

The following is a table of assays scheduled and completed:

	Number of Assays				Total number scheduled	Number included in this final report
	Water	Soil	Vegetation	milk		
Sr^{90}	21	6	18	9	54	54
Zr^{95}	21	6	--	--	27	27
Ru^{130}	21	6	--	--	27	27
Cs^{137}	21	6	18	9	54	54
U(Natural)	21	6	18	--	45	45
Ra^{226}	21	6	18	--	45	45
Th^{232}	21	6	18	--	45	45
K	21	6	18	9	54	54

B. PROCEDURES

The procedures employed by NSEC for the assays requested are summarized as follows:

(1) Sr^{90} was determined using Project Sunshine techniques. Sr^{90} assays were made by isolation of strontium, followed by isolation and determination of the 64 - hr Y^{90} daughter, after radioactivity equilibrium had been achieved. These techniques are described in detail by E. A. Martell, "The Chicago Sunshine Methods, Absolute Assay of Sr^{90} in Biological Materials, Soils, Waters, and Air Filters," AECU-3262, May, 1956, parts of which were developed by NSEC. Further development of the techniques allowed the determination of low-level quantities of Sr^{89} and Sr^{90} in the same sample.

(2) Cs^{137} was determined by isolation of cesium and measurement of Cs^{137} activity by thick sample β-counting.

(3) Zr^{95} was determined by isolation of zirconium and measurement of Zr^{95} activity, free of Nb^{95}, by thick sample β-counting.

(4) Ru^{103} was measured by thick sample β-counting after chemical isolation of ruthenium using RuO_4 distillation. The assay for Ru^{103} was corrected for the Ru^{106} - Rh^{106} present in the sample from measurements of the Rh^{106}, maximum beta energy of 3.5 Mev, counted thru an absorber thick to the Ru^{103}, maximum energy of 80 percent abudant beta of 0.22 Mev.

(5) Total potassium was determined by flame photometric methods with a Beckman flame-photometer.

(6) The weight concentration of uranium was determined by fluormetric techniques. The isotopic abundances for natural uranium and their appropriate decay constants were used to convert to radioactivity concentrations.

(7) Radium was determined after chemical separations using barium as a carrier. Ra^{226} and its disintegration products in non-emanating Ba SO_4 were counted in NSEC's low background α-scintillation counter, specially designed for this work.

(8) Thorium was determined by isolating and measuring the Pa^{233} resulting from the activation of part of the samples in the Brookhaven National Laboratory Reactor.

C. RESULTS

Seven Water Samples assayed in triplicate for radium, uranium, thorium and potassium.

Sample	Aliquot	Radium $\mu c/cm^3$	Uranium $\mu c/cm^3$	Thorium $\mu c/cm^3$	Potassium mg/cm^3
W3 -	1	$< 0.7 \times 10^{-9}$	$1.7 \pm 0.3 \times 10^{-9}$	$< 1 \times 10^{-9}$	$3.18 \pm 0.12 \times 10^{-3}$
	2	< 0.4	1.3 ± 0.3	< 1	3.03 ± 0.16
	3	< 0.8	1.7 ± 0.3	< 1	2.77 ± 0.20
W 10	1	< 0.3	< 0.4	< 1	3.05 ± 0.12
	2	< 0.4	< 0.3	< 1	3.12 ± 0.12
	3	< 1.2	< 0.3	< 1	3.00 ± 0.15
W 11	1	< 0.6	0.4 ± 0.2	< 1	2.38 ± 0.12
	2	< 0.5	< 0.4	< 1	2.20 ± 0.15
	3	< 0.3	0.4 ± 0.2	< 1	2.48 ± 0.12
W 12	1	< 1.5	1.6 ± 0.3	< 1	1.89 ± 0.12
	2	< 2.0	1.6 ± 0.3	< 1	1.65 ± 0.12
	3	< 1.5	2.3 ± 0.4	< 1	1.83 ± 0.12
W 13	1	< 2.5	< 0.3	< 1	1.45 ± 0.10
	2	< 2.5	0.4 ± 0.2	< 1	1.63 ± 0.10
	3	< 4	< 0.3	< 1	1.63 ± 0.10
W 16	1	< 1.5	< 0.3	< 2	1.34 ± 0.10
	2	< 4	< 0.4	< 2	1.78 ± 0.10
	3	< 1.5	< 0.3	< 2	1.80 ± 0.10
W 17	1	< 1.0	2.7 ± 0.4	< 2	1.77 ± 0.10
	2	< 1.0	2.1 ± 0.4	< 2	1.63 ± 0.10
	3	< 0.6	2.3 ± 0.4	< 2	1.89 ± 0.12

Seven water samples assayed in triplicate for Cs^{137}, Sr^{90} Zr^{95} and Ru^{103}.

Sample	Aliquot	Cs^{137} $\mu c/cm^3$	Sr^{90} $\mu c/cm^3$	Zr^{95} $\mu c/cm^3$	Zr^{95} date 1958	Ru^{103} $\mu c/cm^3$	Ru^{103} date 1958
W 3	1	$< 1 \times 10^{-9}$	$<0.3 \times 10^{-9}$	$<2 \times 10^{-9}$	9/6	$< 5 \times 10^{-9}$	10/24
	2	<2	<0.3	<3	9/6	< 4	10/26
	3	<1	<0.3	<3	9/21	< 6	10/28
W 10	1	<2	<0.5	<3	9/6	< 3	10/24
	2	<1	<0.2	<2	9/6	< 4	10/26
	3	<2	<0.2	<3	9/21	< 5	10/28
W 11	1	<2	<0.3	<2	9/6	< 3	10/24
	2	<2	<0.2	<3	9/6	< 4	10/26
	3	<5	<0.3	<3	9/22	< 3	10/29
W 12	1	<1	<0.5	<2	9/6	< 3	10/25
	2	<1	<0.2	<2	9/6	< 5	10/26
	3	<3	<0.3	<3	9/21	< 3	10/29
W 13	1	<5	<0.6	<6	9/6	< 6	10/24
	2	<4	<0.5	<10	9/6	< 8	10/26
	3	<2	<0.6	<5	9/21	< 12	10/30
W 16	1	<2	<1.0	<3	9/6	< 3	10/24
	2	<1	<0.3	<3	9/6	< 3	10/26
	3	<2	<0.3	<2	9/21	< 4	10/31
W 17	1	<1	<0.3	<3	9/6	< 3	10/24
	2	<2	<0.3	<2	9/7	< 8	10/26
	3	<1	<0.6	<2	9/21	< 3	10/30

Six soil samples assayed for Sr^{90}, Cs^{137}, Zr^{95}, Ru^{103}, radium, thorium, uranium and potassium.

	Sr^{90} µc/g*	Cs^{137} µc/g*	radium µc/g*
S-1	$0.178 \pm 0.013 \times 10^{-6}$	$0.22 \pm 0.04 \times 10^{-6}$	$0.29 \pm 0.04 \times 10^{-6}$
S-7	0.147 ± 0.014	0.23 ± 0.05	0.20 ± 0.03
S-8	0.160 ± 0.013	0.34 ± 0.05	0.60 ± 0.06
S-9	0.087 ± 0.014	0.68 ± 0.15	0.39 ± 0.05
S-10	0.131 ± 0.014	0.14 ± 0.04	0.70 ± 0.07
S-11	0.180 ± 0.018	0.40 ± 0.12	0.030 ± 0.008

	Zr^{95}		Ru^{103}	
	µc/g*	date	µc/g*	date
S-1	$0.53 \pm 0.05 \times 10^{-6}$	11/5/58	$< 0.2 \times 10^{-6}$	10/31/58
S-7	0.17 ± 0.09	11/7/58	< 0.3	10/30/58
S-8	0.15 ± 0.05	11/8/58	< 0.7	10/29/58
S-9	0.89 ± 0.10	11/7/58	< 1.0	10/29/58
S-10	0.17 ± 0.06	11/7/58	< 0.5	10/29/58
S-11	0.17 ± 0.10	12/19/58	< 0.7	10/29/58

	Thorium µc/g*	Uranium µc/g*	Potassium mg/g*
S-1	$1.1 \pm 0.4 \times 10^{-6}$	$36 \pm 11 \times 10^{-9}$	0.36 ± 0.02
S-7	1.1 ± 0.4	17 ± 8	0.66 ± 0.04
S-8	0.9 ± 0.3	73 ± 15	0.66 ± 0.03
S-9	0.5 ± 0.2	75 ± 15	0.31 ± 0.02
S-10	0.6 ± 0.2	< 15	0.69 ± 0.03
S-11	0.7 ± 0.3	94 ± 15	0.82 ± 0.03

* gram of dry soil

Six vegetation samples assayed in triplicate for Sr^{90}, Cs^{137} and radium.

Sample	Aliquot	Sr^{90} μc/gm	Cs^{137} μc/gm	radium μc/g
D	1	$1.00 \pm 0.25 \times 10^{-6}$	$5.0 \pm 0.7 \times 10^{-6}$	$0.30 \pm 0.05 \times 10^{-6}$
	2	0.98 ± 0.15	3.0 ± 0.8	0.43 ± 0.07
	3	1.11 ± 0.10	3.3 ± 0.7	0.35 ± 0.07
F	1	0.52 ± 0.07	2.3 ± 0.3	0.07 ± 0.03
	2	0.49 ± 0.05	1.9 ± 0.3	0.07 ± 0.03
	3	0.40 ± 0.05	1.1 ± 0.2	0.08 ± 0.03
S	1	0.81 ± 0.12	2.3 ± 0.3	0.24 ± 0.05
	2	0.87 ± 0.10	1.8 ± 0.3	0.39 ± 0.06
	3	0.76 ± 0.10	1.8 ± 0.5	0.32 ± 0.06
W	1	1.00 ± 0.08	3.5 ± 0.4	0.03 ± 0.02
	2	1.20 ± 0.08	3.7 ± 0.4	0.04 ± 0.02
	3	0.37 ± 0.10	1.7 ± 0.3	< 0.04
X	1	0.45 ± 0.07	2.1 ± 0.4	0.06 ± 0.03
	2	0.43 ± 0.06	2.0 ± 0.5	< 0.05
	3	0.43 ± 0.07	1.5 ± 0.4	< 0.04
Y	1	3.2 ± 0.3	6.0 ± 0.5	0.17 ± 0.04
	2	2.5 ± 0.2	5.0 ± 0.8	0.19 ± 0.04
	3	3.1 ± 0.2	6.2 ± 0.5	0.17 ± 0.04

Six vegetation samples assayed in triplicate for thorium, uranium, and potassium.

Aliquot		Thorium μc/g	Uranium μc/g	Potassium mg/g
D	1	7.1 ± 1.3 x 10^{-9}	10 ± 3 x 10^{-9}	31.4 ± 1.5
	2	11.1 ± 1.8	< 4	33.4 ± 1.5
	3	5.0 ± 1.2	15 ± 4	32.2 ± 1.2
F	1	35 ± 6	1.9 ± 1.0	7.6 ± 0.7
	2	28 ± 5	4.2 ± 1.5	8.1 ± 0.8
	3	23 ± 4	3.8 ± 1.5	8.1 ± 0.8
S	1	59 ± 10	11 ± 3	46.1 ± 1.5
	2	39 ± 8	16 ± 4	46.6 ± 1.2
	3	75 ± 12	23 ± 5	46.5 ± 1.5
W	1	3.7 ± 0.7	8 ± 3	21.7 ± 1.2
	2	3.6 ± 0.6	6 ± 2	22.0 ± 1.2
	3	3.3 ± 0.6	4 ± 2	22.8 ± 1.2
X	1	5.0 ± 0.9	7 ± 3	28.0 ± 2.0
	2	4.7 ± 0.9	8 ± 3	27.4 ± 1.5
	3	1.9 ± 0.8	9 ± 3	27.2 ± 1.5
Y	1	74 ± 15	14 ± 3	55.8 ± 1.5
	2	47 ± 5	19 ± 4	53.5 ± 1.5
	3	35 ± 8	18 ± 4	58.1 ± 1.5

Three milk sample assayed in triplicate for Sr^{90}, Cs^{137} and potassium.

Sample	Aliquot	Potassium % ash	$\mu\mu c$ Sr^{90}/g Ca	$\mu\mu c$ Cs^{137}/mg K
517	1	18 ± 2	5.1 ± 0.5	11 ± 3
	2	18 ± 2	3.5 ± 0.6	11 ± 3
	3	19 ± 2	5.0 ± 0.6	< 15
823	1	18 ± 2	7.0 ± 0.7	59 ± 10
	2	17 ± 2	5.2 ± 0.9	59 ± 10
	3	17 ± 2	6.3 ± 0.8	77 ± 8
844	1	16 ± 2	4.0 ± 0.7	37 ± 7
	2	17 ± 2	2.7 ± 0.7	< 60
	3	17 ± 2	3.7 ± 0.5	43 ± 13

D. Discussion of errors

The errors given in the tables of results are the standard deviations of the final result for a single determination.

For Sr^{90}, Zr^{95}, Ru^{103}, Cs^{137}, radium and thorium, this error consists of:

(1) counting error; varies from ± 3 to 50 percent as a function of the quantity of species to be determined in the original sample.

(2) chemical yield determination; estimated ± 3 percent

(3) calibration error used in correcting counting rate of counted sample to disintegration rate; ± 3 to 8 percent, depending on species.

For uranium and total potassium this error is a measure of the precision of replicate concentration measurements by direct comparison with a standard concentration.

Where a result is listed as less than a given value, this value represents the upper limit at the 2σ (95%) confidence level. Assays with a counting error of greater than ± 50 percent are reported in this manner.

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13 ABSTRACT

This environmental radioactive background survey was an attempt to establish a base line of the normally occurring radioactivity in the fauna and flora of a particular area subsequent to the operation of a reactor which will release additional radioactivity to the environment. The Health Physics Office of the AF NETF has collected samples of water, soil, air, sewage, milk, biological life and vegetation in a 20 mile radius of the AF NETF site and analyzed the samples for alpha, beta and gamma activity. The results of the analyses over the period of the report are given in graphic form to facilitate making comparison of the fluctuations in the normal background. The wide variations were due to the atom bomb testing not only in the United States but throughout the world. The tests especially noticeable are the result of the last half quarter of 1958 when the atom bomb testing was at a peak.

Future samples taken from the same areas will be analyzed when the reactor becomes operational. Comparison then can be made to determine any increased activity which may be attributable to the AF Nuclear Reactor operation.

In order to obtain certain quantitative analyses of the radioactive content of the various samples collected a contract was awarded the Nuclear Science and Engineering Corporation of Pittsburgh, Pennsylvania. The result of their work will be found in Appendix II of the report.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
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